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MARINE SPATIAL PLANNING

FACILITATING SUSTAINABILITY IN AN OCEAN OF AMBIGUITY

BY
TRINE SKOVGAARD KIRKFELDT

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Facilitating sustainability in an ocean of ambiguity

by

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Summary

This report presents a PhD project that was carried out over three years, from January 2018 to January 2021, at the Centre for Blue Governance at Aalborg University, Denmark. The report consists of five papers, prepared for this dissertation, as well as introducing chapters that present the topic, research design and collated research findings.

The research theme of this dissertation is the practice of Marine Spatial Planning (MSP). MSP is a developing planning practice that aims to plan for the spatial division of activities at sea in order to meet objectives for a sustainable future. The practice of MSP became a necessity due to the increasing level of activity at sea and the increasing pressure from human activities that result in the deterioration of marine ecosystems. The project was guided by the following research question:

How is Marine Spatial Planning facilitating sustainability at sea?

In addition, three sub-questions have supported the research by focusing on the potential role of MSP in facilitating sustainability and the role of policy ambiguity in the current practice of MSP. The theoretical concept of policy ambiguity is central to the conducted research in terms of how ambiguities in MSP policies can have constructive as well as less-constructive outcomes. The conceptual framework of this dissertation also includes theory on how policy ambiguity can affect implementation processes, along with theory on how people generate meaning from perceived information. Guided by the conceptual framework, this dissertation investigates how policies on MSP support the achievement of sustainability objectives, and how MSP practitioners interpret ambiguously formulated policies.

The five papers all contribute to addressing the research questions but from different perspectives. Paper 1 explores how three interrelated concepts are perceived by MSP experts, i.e. the 'ecosystem-based approach', 'ecosystem approach' and 'ecosystem-based management' concepts. Paper 2 compares the policy designs of the German, Danish and Norwegian MSP processes as well as how planners interpret the sustainability concept. Paper 3 examines the current practice of assessing collective pressure as part of MSP processes in EU member states. Paper 4 elaborates upon the 'ecosystem-based approach' concept and compares 'best practices', as suggested by MSP experts. Paper 5 presents a conceptual definition of MSP based on the most cited publications and discusses how MSP can contribute to the achievement of UN Sustainable Development Goal

14 for life below water.

The research conducted for the five papers found that ambiguities in the EU Directive for MSP, as well as national policy designs, leave significant room for planners and other actors in the MSP process to interpret central concepts and formulations. These include the practice of taking an 'ecosystem-based approach' and the aim of ensuring that the collective pressure stays below a level compatible with a good environmental status. In some cases, this freedom of interpretation leads to innovative and effective MSP practices that facilitate sustainability at sea, whereas other cases show few signs of an 'ecosystem-based approach' and the outcome is therefore not sure to facilitate sustainability.

Danish summary/Dansk resumé

Denne rapport præsenter et PhD-projekt, der strakte sig over tre år, fra januar 2018 til januar 2021, ved Centre for Blue Governance på Aalborg Universitet. Rapporten består af fem artikler, udviklet til afhandlingen, samt indledende afsnit, der præsenterer emnet, forskningsdesignet og en sammenfatning af forskningsresultaterne.

Afhandlingens emneområde er praksissen havplanlægning. Havplanlægning er en udviklende planlægningspraksis, der søger at planlægge for den rumlige fordeling af aktiviteter til søs, med målsætninger om bæredygtighed. Behovet for havplanlægning kommer af det stigende aktivitetsniveau til søs samt den stigende påvirkning som menneskelige aktiviteter påfører det marine miljø med ødelæggende følger. Projektet blev guidet af følgende forskningsspørgsmål:

Hvordan understøtter havplanlægning bæredygtighed til søs?

Herudover har tre underspørgsmål støttet forskningen ved at fokusere på havplanlægnings-praksissens potentiale for at understøtte en bæredygtig fremtid, samt hvordan flertydige formuleringer i politikker påvirker den nuværende praksis. Det teoretiske begreb, politisk flertydighed (Eng.: policy ambiguity), er centralt i undersøgelsen af, hvordan flertydige formuleringer i havplanlægningspolitikker kan resultere i både konstruktive og mindre konstruktive udfald. Afhandlingens begrebslige forståelsesramme indebærer også teori om, hvordan flertydige formuleringer i politikker kan påvirke implementeringen af en politik, i tillæg til teori om hvordan mennesker gennemgår en fortolkningsproces for at skabe mening af information. Vejledt af den begrebslige forståelsesramme belyser afhandlingen, hvordan havplanlægningspolitikker understøtter opnåelsen af målsætninger om bæredygtighed, samt hvordan aktører i havplanlægningsprocesser fortolker flertydige politik-formuleringer.

De fem artikler har alle bidraget forskelligt til besvarelsen af forskningsspørgsmålet. Artikel 1 undersøger hvordan tre enslydende begreber er opfattet af eksperter i havplanlægning, i.e. begreberne 'økosystembaseret tilgang', 'økosystem tilgang' og en 'økosystembaseret forvaltning'. Artikel 2 sammenligner politikkerne for havplanlægning i Tyskland, Danmark og Norge, samt hvordan planlæggerne fortolker bæredygtighedsbegrebet. Artikel 3 undersøger den nuværende praksis af vurderingen af den samlede miljøpåvirkning i EU medlemsstaters havplanlægnings-praksisser. Artikel 4 evaluerer begrebet 'økosystembaseret tilgang', og sammenligner de bedste

eksempler på denne praksis, udvalgt af havplanlægningseksperter. Artikel 5 opbygger en definition af havplanlægning baseret på de mest citerede definitioner, og diskuterer havplanlægnings-praksissens potentiale i opnåelsen af FN's bæredygtighedsmål 14 om livet under havet.

De fem artikler viser, hvordan flertydighed i EU-direktivet for havplanlægning, såvel som nationale politikker for havplanlægning, overlader fortolkningen af centrale begreber og formuleringer til involverede planlæggere, heriblandt praksissen at tage en økosystembaseret tilgang, samt at sikre at den samlede miljøpåvirkning ikke forhindrer opnåelsen af en god miljøtilstand. I nogle tilfælde fører denne fortolkningsfrihed til innovative og effektive havplanlægnings-praksisser, der understøtter en bæredygtig fremtid for havet, hvorimod andre havplanlægnings-praksisser udviser en utilstrækkelig praktisering af en økosystembaseret tilgang og kan derfor ikke siges at understøtte bæredygtighed til søs.

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While the life of a PhD student at times can feel like an isolated and detached journey, this is far from the case. Many people have had a tremendous role to play in the outcome of the project, and for this, I would like to give my acknowledgements.

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Table of content

Abbreviations

CIA	Cumulative Impact Assessment
EA	Ecosystem Approach
EBA	Ecosystem-based Approach
EBM	Ecosystem-based Management
EU	European Union
GES	Good Environmental Status
IMP	Integrated Maritime Policy
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
MSP	Marine Spatial Planning
MSPD	Marine Spatial Planning Directive
UNCLOS	United Nations Convention on the Law of the Sea
WFD	Water Framework Directive

Publications

T. S. Kirkfeldt (2019) An ocean of concepts: why choosing between ecosystem-based management, ecosystem-based approach and ecosystem approach makes a difference, *Marine Policy* (106), p. 103541, Elsevier Ltd, doi: 10.1016/j.marpol.2019.103541.

T. S. Kirkfeldt, van Tatenhove J.P.M., Nielsen H.N. and Larsen S.V. (2020) An ocean of ambiguity in Northern European marine spatial planning policy designs, *Marine Policy* (119), p.104063, Elsevier Ltd, doi: 10.1016/j.marpol.2020.104063

T. S. Kirkfeldt and Andersen J.H. (2020) Assessment of collective pressure in marine spatial planning: The current approach of EU Member States, *Ocean and Coastal Management*, Elsevier Ltd, doi: 10.1016/j.ocecoaman.2020.105448.

T. S. Kirkfeldt, van Tatenhove J.P.M. and Calado H. M. G. (submitted) Innovative diversity: the way forward on Ecosystem-based Marine Spatial Planning, submitted to *Coastal Management* on January 14 2021.

T. S. Kirkfeldt and Santos C. F. (under review) A review of sustainability concepts in marine spatial planning and the potential to supporting the UN SDG 14, submitted to *Marine Policy* on Nov 4 2020, went into review on Nov 24 2020.

Other publications related to the dissertation theme

T. S. Kirkfeldt, Hansen A.M., Olesen P., Mortensen L., Hristova K., and Welsch A. (2017) Why cumulative impacts assessments of hydrocarbon activities in the Arctic fail to meet their purpose. Reg. Environ. Change 17, 725–737. doi: 10.1007/s10113-016-1059-3.

T. J. Hegland, Kirkfeldt T. S., Jacobsen R. B., Lyhne I., Nielsen H. N. and Sattari S. (2020) Havforvaltningen i Danmark, Aalborg Universitet,

P. Ramírez-Monsalve, Nielsen K. N., Ballesteros M., Kirkfeldt T. S., Dickey-Collas M., Delaney A., Hegland T. J., Raakjær J. and Degnbol P. (2021) Pulling mechanisms and pushing strategies: How to improve Ecosystem Approach Fisheries Management advice within the European Union's Common Fisheries Policy, *Fisheries Research* (233), p. 105751, doi: 10.1016/j.fishres.2020.105751

INTRODUCTION

For millennia, the ocean has been an alien environment for humans, despite our marine origin. When humankind first ventured out to sea, it was primarily for migratory purposes. Colonisation patterns indicate that ocean crossing migrations have been taking place since at least 40,000 BCE. However, humans were living off the ocean long before they attempted to cross it. Prehistoric archaeological discoveries show that fishing has been a key source of sustenance for civilisations since at least the first millennium BCE (Hattendorf(b), 2007). For many years, fishing and seafaring were the main human activities at sea. It was not until the twentieth century that other activities started to expand out to sea. The first offshore oil exploration took place in 1945 in the Gulf of Mexico and was followed by explorations in the North Sea two decades later (Hattendorf(a), 2007). Around the same time, sedimentary resources, such as sand and gravel, were increasingly being extracted for construction purposes or beach nourishment (Walker *et al.*, 2016). In the 1960s, high concentrations of mineral resources were discovered on the seafloor and attempts were made to recover these resources; however, the extraction was found to be too costly (Cuyvers *et al.*, 2018). Due to a growing number of depleted fish stocks the development of mariculture took off in the 1970s and 1980s and has, since then, been growing steadily (Matthews, 2014). In 2016, aquaculture surpassed wild capture and is, today, the largest supplier of seafood (FAO, 2020). At the end of the twentieth century, the need to increase renewable energy production led to a new use for marine space. The first offshore wind farm was built in the southeast of Denmark in 1991, which was the beginning of an ongoing development of marine space for energy purposes all over the world (WindEurope, 2019).

Until the twentieth century, humans had mostly viewed the ocean from above and had little insight into the world beneath the surface. The ocean was mainly perceived as a source of food and means of transportation, which often led to high casualties on ocean crossings and in stormy weather. Due to its mysterious nature, legends of a giant squid, crewless ships and an area called the Bermuda Triangle where everything disappears, have dominated the discourse on the sea (Hogenboom, 2014; History, 2018). Today, the sea is still subject to legends and myths, and with good reason. While only 5% has been explored, 95% of the world's oceans remain unexplored (Hogge, 2017). While 5% may not seem significant, the ability for humans to travel below the surface has allowed scientists to explore this world and, with the assistance of underwater photography, people can now travel into the ocean while being hundreds of miles

from the sea. Most underwater technologies were developed in the twentieth century, although attempts of underwater vessels and scuba gear were invented earlier. Today, humans are still developing technologies to go even further and deeper (Bellis, 2019).

As human activities have diversified and expanded so have the negative impacts of these activities. Oceans are today under pressure from various human activities, which have led to pollution, oxygen-depleted ecosystems, habitat destruction and depleted fish stocks, along with impacts related to a changing climate (Allsopp *et al.*, 2009; European Environment Agency, 2019). Fishing was the first maritime activity to result in impacts that closed down entire industries. A third of the world's fish stocks are today at unsustainable levels, while global seafood production continues to increase (FAO, 2020). Another severe impact of fishing activities is the destruction of habitats through bottom trawling. In Europe, bottom trawling activities affect about 35% of the continental shelf. Consequently, bottom trawling is found to be the activity in Europe with the largest spatial impact. Depending on the type of sediment and ecosystem in the area being trawled, these can take decades, and in some cases, centuries to recover from one single trawling event (Korpinen *et al.*, 2019). While mari-culture started to expand as a response to depleted fish stocks, this too has led negative impacts on the environment, such as inputs of medicine residues and the risk of disease transmission to wild stocks as well as eutrophication due to an excess of nutrients (Naylor and Burke, 2005). Other activities with negative impacts include oil and gas activities and shipping. Major oil spills have occurred in relation to the transportation of oil by tank ships and at oil platforms, which was the case with the largest oil spill in history. The Blue Water Horizon oil spill, which started in 2010, had an estimated discharge of about 500 million litres of crude oil into the environment causing severe damage (NOAA, 2019; Rafferty, 2020). Like most human activities, shipping affects marine ecosystems through sound pollution. Sound waves disturb the communication of marine mammals and have been found to change the behaviour of both marine mammals and fish species (Jägerbrand *et al.*, 2019). Other impacts from human activities include litter pollution, disturbance to the seafloor from physical structures, such as wind farms and bridges, and increasing acidification due to the growing concentration of CO_2 in the atmosphere, which results in reduced growth rates in skeletons and shells (IPCC, 2019).

The level of activity at sea is having a severe impact on marine ecosystems, which reduces their ability to deliver primary services to humans. Besides the supply of resources, such as food and energy, the ocean also provides other important ecosystem services, such as recreational values, coastal protection and climate regulation. The ocean is estimated to consume 90% of the excess

heat from global warming and 60% of the CO_2 produced by human activities, while, at the same time, delivering at least 50% of the oxygen in the atmosphere (IPCC, 2014; NOAA, 2020).

With our increasing knowledge of the marine world, and an increasing interest in what it offers, a need to manage how humans use ocean resources has become urgent. The fluid and intangible nature of the ocean makes it challenging to manage activities as well as their impacts. Activities are easily invisible at sea, which makes them difficult to monitor and regulate. The question remains: How can we manage something so fluid and unmanageable?

Managing the sea space

The first time the ocean was divided for national sovereignty was in 1493 when Pope Alexander VI proposed a treaty between Spain and Portugal that split the new world in two with a line going from the North to the South Pole across the Atlantic Ocean (Natkiel and Preston, 1986). Based on this proposition, the Treaty of Tordesillas was signed a year later with a line placed slightly west of the Pope's suggestion, across Brazil, ascribing most of Brazil and everything east of the line to Portugal and everything west of the line to Spain. Even though the treaty was not recognised by countries other than Spain and Portugal, it brought peace to the dispute between the two empires. In spite of a strong focus on the division of land, a sovereignty claim for the ocean was implicit in the treaty (Hattendorf(a), 2007).

During the century following the adoption of the treaty, other countries started making claims of their own for ocean territories. Denmark claimed sovereignty over the ocean surrounding Iceland, Greenland and the Faroe Islands with the purpose of ensuring fishing rights, and Sweden claimed sovereignty over the Baltic Sea. While Portugal and Spain still maintained the Treaty of Tordesillas, it became clear that there was a need for a globally acknowledged framework to manage and divide marine space (Hattendorf(a), 2007). In the creation of this framework, two leading views were dominant and are today still present in maritime legislations. The two views are those of *Mare Librium* and *Mare Clausum*.

Mare Librium vs Mare Clausum

The first official opposition to the Treaty of Tordesillas was formulated by the Dutch lawyer, Hugo Grotius. His objection to the treaty was built on theoretical arguments and 'laws of nature' and was centred on the notion that no man or country could claim sovereignty over the seas. This came after Dutch trading ships had been denied access to shipping routes and trading ports by the

Portuguese, who claimed their right under the Treaty of Tordesillas. Grotius' arguments were therefore mostly focused on the freedom of navigation and trade. He published his objection and the notion of the freedom of the high seas in a document called *Mare Librium,* on behalf of the Dutch East India Company, in 1609 (Thornton, 2004).

The Dutch were not alone in the contention of a free ocean. In 1580, the English Queen, Elizabeth I, declared that the ocean could not be possessed by any nation and that use of water and air was open to all. She also rejected the Danish claim to the northern seas, which was supported by France, declaring that the ocean is common to all (Hattendorf(a), 2007).

While the notion of a free and open ocean gained increasing support, there were ongoing discussions on whether a small zone along the coastline of a state should be within national jurisdiction. As a response, John Selden, an English legal counsellor, started working on a document opposing the idea of the seas being free and open to all. He was employed by the royal court to defend British rights over coastal areas. He finished his manuscript in 1619, but the document, *Mare Clausum*, was not approved until after a revision in 1635. At this point, Hugo Grotius had already ascribed to the notion that some areas of the seas extending from a nation's coast, including straits and bays, could be governed under national jurisdictions (Leaffer, 1584).

The publication of the two documents, *Mare Librium* and *Mare Clausum*, was followed by a period of debate and conflict, also known as the battle of the books. This debate went on for the rest of the century. In the end, the debate resulted in a reconciliation of the two documents with a doctrine for *the freedom of the seas* for the high seas and a developing practice and debate over the extent of national claims for sovereignty over coastal areas (Hattendorf(a), 2007).

National claims for the sea

The initial width of territorial sovereignty was set at three miles based on the phrase 'terrae dominum finitur, ubi finitur armorium vis', which translates as 'the dominion of the land ends where the range of weapons ends', which came to be known as the canon-shot rule (Gooch and Williams, 2007; Dauchy et al., 2016). The rule gave nations exclusive rights over the exploitation of natural resources and was widely accepted and used in several regulations and treaties during the eighteenth and nineteenth century (Gooch and Williams, 2007).

Following the canon-shot rule nations around the globe started claiming their territorial seas, which meant excluding other nations from fishing areas. In combination with an increase in depleted fish stocks, this ignited a debate and conflict over the existing system. At the Hague Conference in 1930, overfishing

and the need for conservation measures beyond the three-mile limit were therefore debated (Hattendorf(a), 2007). In 1945, the United States claimed, through the Truman Declaration, the right to control fishing activities beyond their three-mile limit as well as sovereignty over resources on their continental shelf (Hattendorf(a), 2007). The latter claim was of particular importance, as it ensured the protection of future oil production (Kurlansky, 1999). Shortly after, Norway claimed an extension of their territorial waters to one Scandinavian mile (corresponding to four miles), following Denmark, who had made the same extension in 1812, and was given the right to do so by the International Court of Justice after a dispute with the British. Iceland then followed, having gained independence from Denmark in 1944. This extension was objected to by British, Dutch, French and Belgian governments without success. As a result, the British placed an embargo on Icelandic fish, which turned out to be a warm-up to the long conflict of the Cod Wars, also known as the wars for the territorial waters (Kurlansky, 1999). The Cod Wars consisted of three independent wars, mainly between Iceland and Great Britain, with few casualties but tremendous damage to fishing boats and ships. The last battle ended in 1976, when an agreement was signed, and Britain retreated (Guðmundsson, 2006).

Common management regimes

During the second half of the twentieth century, many conventions were held to settle questions on how to manage disputes between neighbouring states, fishing rights, upcoming maritime industries and the threat to marine ecosystems. These conventions were still influenced by Grotious' doctrine on the freedom of the seas from the seventeenth century and the Truman Declaration from 1945. The formulation of an international law for the seas required many negotiations, which were carried out over a period of twelve years. The first and second UN conferences on the Law of the Sea were held in 1958 and 1960 at which many issues were discussed, although not all were settled. The issues concerning territorial waters and fishing rights were especially difficult to settle (Hattendorf(c), 2007). During the sixties, the debate was expanded to include the newly discovered mineral resources on the seafloor. Countries worried how the notion of the freedom of the seas would influence the future extraction of seabed minerals (SPC, 2013). In 1982, the UN Convention on the Law of the Sea (UNCLOS) was finally approved. UNCLOS is, to date, the most dominant and central framework for the global management of marine space and resources, setting rules and regimes for the following:

(1) the freedom of navigation,
(2) the twelve nautical mile limit for territorial seas,
(3) the exclusive economic zone set at 200 nautical miles from shore,
(4) the extension of the continental shelf right up to 350 nautical miles,
(5) the establishment of the International Seabed Authority (ISA),
(6) mechanisms for resolving conflicts.

(United Nations, 1982)

While UNCLOS was under development, the increasing pressure on the marine ecosystem called for additional international frameworks (National Research Council, 2001). The Convention on Conservation of the Living Resources of the High Seas was signed in 1958 as part of the first UN conference on the Law of the Sea in Geneva. It states that members of the convention: *"(…) shall cooperate with each other in the conservation and management of living resources in the areas of the high seas*" (United Nations, 1982, art. 118 p. 65). In 1962, the First World Conference on National Parks was held. At this conference, the idea of conserving specific habitats and species was shaped. This concept was further developed at the Ramsar Convention (on Wetlands of International Importance Especially as Waterfowl Habitat) in 1971, which provided a framework for nations to establish Marine Protected Areas (MPAs). The concept of MPAs then evolved at conferences and conventions during the seventies and eighties, led by UNCLOS, the UN Environment Programme, the UN Educational, Scientific, and Cultural Organization (UNESCO) and the International Union for the Conservation of Nature (IUCN). At the end of the twentieth century, guidelines, policy frameworks and plans for conservation were established. Especially during the last three decades of the century, there was a significant increase in the number of MPAs, from 118 in 1970 to well over 1,300 by the end of the century (National Research Council, 2001).

In 1992, the Convention on Biological Diversity (CBD) was established with the objective of pursuing the conservation and sustainable use of biological diversity (CBD, 2019). The CBD has been in charge of the global establishment of MPAs since 2006, with 193 signatory states dedicated to protecting more than 10% of the marine environment (Klein *et al.*, 2015).

While the total size of protected areas increased, so did the pressure on marine ecosystems. It became clear that more holistic and integrated management efforts were necessary in order to avoid depleting the marine ecosystems and the economies that rely on the services they provide. From this need, the practice of Marine Spatial Planning developed.

Marine spatial planning: a new planning practice

The first practices of spatial planning are known to have taken place on land in Mesopotamia and Ancient Greece; however, the practice of spatial planning as we know it today developed primarily over the last century. Spatial planning developed as a response to the need for the management of economic and social problems kindled by the industrial revolution. Initially, the practice was predominantly oriented towards the management of urban and agricultural development. However, with time, spatial planning turned to focus on environmental problems as well (Sanyal, 2012; Kidd and Shaw, 2013; Gazzola and Onyango, 2018). Over the last couple of decades, spatial planning has moved out to sea through the practice of Marine Spatial Planning (MSP). China initiated its first round of ocean zoning in 1998, and, in Europe, the first integrated management plans were in place in 2005 in Belgium, Germany and the Netherlands. MSP is often seen to stem from the development of MPAs in the seventies and eighties, most famously the development of the Great Barrier Reef Marine Park, which is predominantly oriented towards managing the impact of human activities (Kirkfeldt, van Tatenhove and Calado *submitted*; Gee and Zaucha, 2019). While some of the initial MSP practices were primarily driven by environmental objectives, MSP is now more focused on user-user conflicts rather than user-environment conflicts (Douvere, 2008; Collie *et al.*, 2013; Trouillet, 2020).

At the time of writing this, 79 nations are known to have MSP practices in place (UNESCO, 2020). The increasing practice of MSP has inspired a long list of questions and uncertainties concerning the concept of MSP and what the practice entails (Gee and Zaucha, 2019). While there are many different suggestions for what MSP is (cf. e.g. Ehler and Douvere, 2009b; Foley *et al.*, 2010; The White House, 2010), a representative definition is presented by Kirkfeldt and Santos (under review):

> Marine spatial planning is a public, planning process and an element of ecosystem-based sea use management that aims to prevent conflicts among maritime uses and between human uses and the environment, through a strategic and rational, spatial and temporal, distribution of activities in order to achieve environmental, social and economic objectives, such as sustaining ecosystem services and improve decision-making. (Kirkfeldt and Santos *under review*)(p. 175 of this dissertation)

The process of MSP is often managed by a public agency and involves several steps (see Figure 1). While no two processes are alike, MSP can consist of the following steps. First there is a pre-planning stage in which the timeframe and responsibilities are set, along with the key objectives of the plan. This is often followed by the planning of stakeholder participation, in which relevant stakeholders are identified and a plan is made for how and when to involve these stakeholders. Then follows an assessment of the current conditions, i.e. the

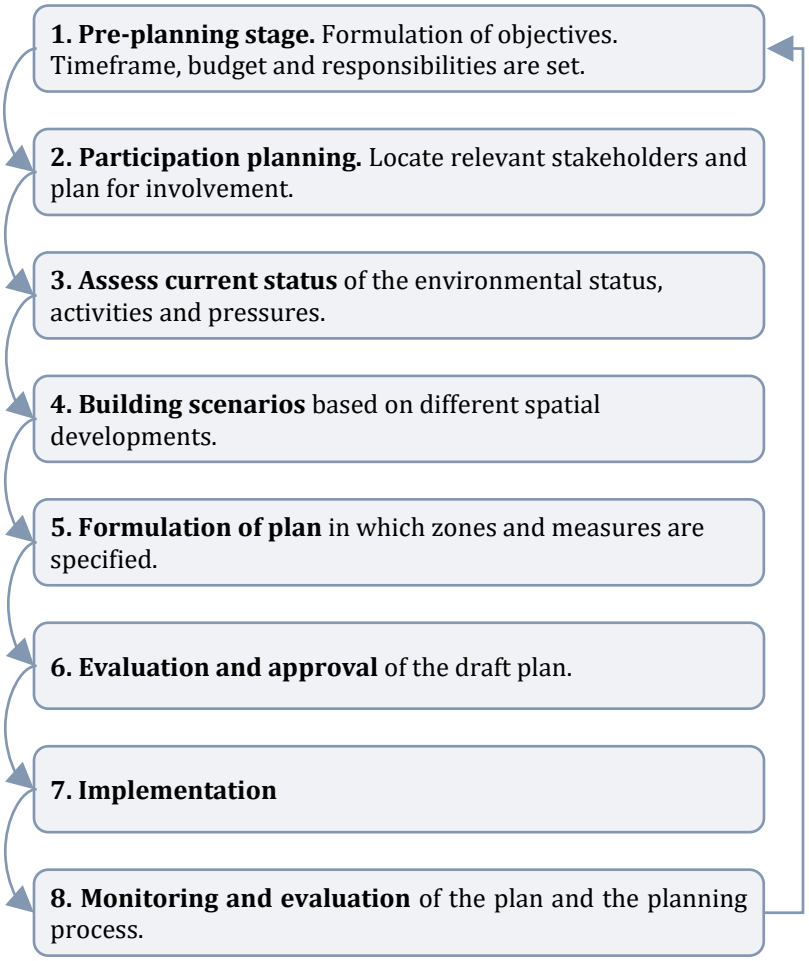


Figure 1 A simplistic illustration of key stages in an MSP process. Inspired by (Ehler and Douvere, 2009).

environmental status and the current extent of human activities and pressures. From this, future conditions can be predicted in the following stage, and different scenarios of future uses, based on spatial demands, can be assessed. The preferred scenario can then be chosen, after which the plan can be developed, including the appointment of zones and measures. The plan is then evaluated, approved and implemented, followed by the enforcement and monitoring of the plan and its progress (Ehler and Douvere, 2009).

Key to MSP is its holistic and integrated character; hence, it is essential to include a wide range of maritime activities in the planning process. The assessment of Kirkfeldt and Santos (under review) summarised a list of activities to include in MSP, drawn from the most cited publications on MSP. These are depicted in Figure 2.

Figure 2 shows clear connections to MSP's origin in environmental conservation/protection. It also shows that activities that are often prone to conflict, such as renewable energy (predominantly wind farms) and fishing activities, receive more attention in MSP literature and research than activities that are more seldom involved in conflict (Kirkfeldt and Santos *under review*). The conflict-prone activities are highly concentrated in European seas, with some of the busiest shipping routes in the world and the expanding construction of wind farms (Bennett and Christie, 2010; Korpinen *et al.*, 2019). While some European Union (EU) member states had already taken on the practice of MSP, the European Commission saw the need for more integrated and holistic management to be practiced throughout the EU.

Marine spatial planning in the European Union

Some of the busiest and most crowded marine areas in the world can be found in Europe, where relatively small states have had thriving economies and maritime industries for centuries (Miller, 2012; DNV.GL, 2020). In 2007, the interconnectedness and development of activities led to the establishment of the Integrated Maritime Policy (IMP). The objective of the IMP is to ensure the sustainable development of the maritime economy and to protect the marine environment of Europe (European Commission, 2012). The EU had, at that time, been experiencing problems with fisheries regulations for decades, despite the establishment of the Common Fisheries Policy (CFP) in the seventies (Martí, 2018). While the main focus of the CFP is to ensure sustainable fishing, this has proved to be challenging, and attempts to achieve the objective through regulations and quota systems has so far not been successful (Symes, 1997; Hegland, 2012). As a result, the IMP was partly formulated with the objective of

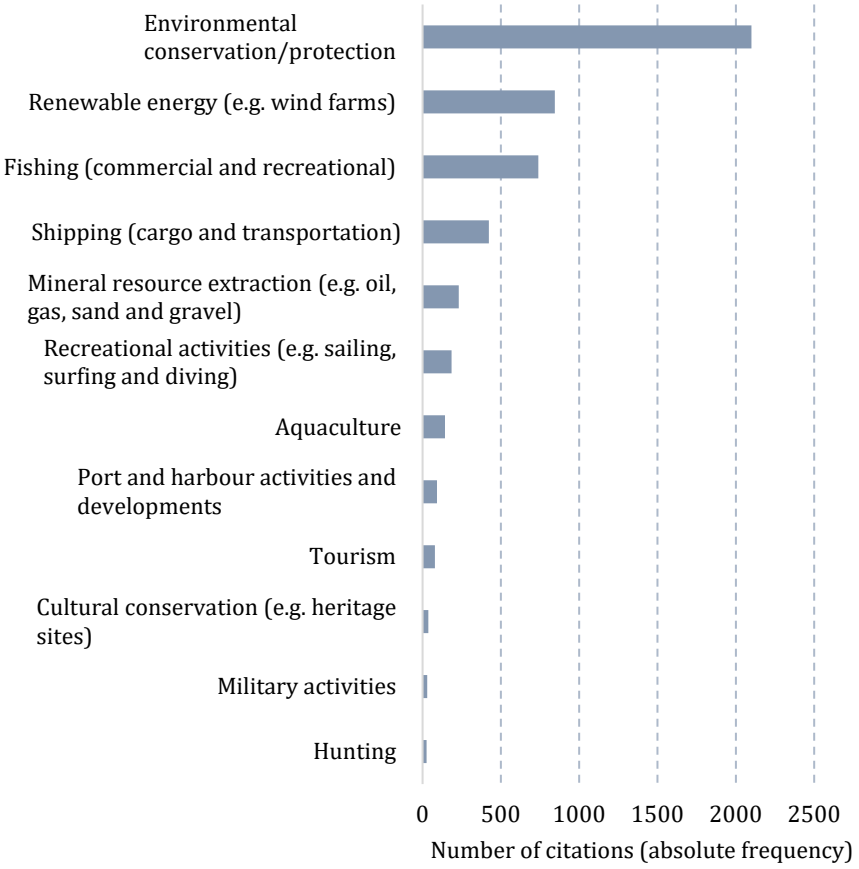


Figure 2 From Kirkfeldt and Santos (under review). The list of activities to include in MSP listed according to the number of times mentioned in the 50 most cited publications on MSP.

addressing issues that had proved challenging to address through the CFP by applying a more integrated and holistic management approach.

Shortly after the establishment of the IMP, a directive was approved as the environmental pillar of the policy (European Commission, 2021). The Marine Strategy Framework Directive (MSFD) was established in 2008 with the aim of ensuring a good environmental status for the marine environment. For this purpose, the Directive requires that each member state have national strategic plans for their marine environments (Directive 2008/56/EC).

In 2014, another pillar of the IMP was developed through the Maritime Spatial Planning Directive (MSPD, Directive 2014/89/EU) with the intention of strengthening the integrated planning of activities in European seas by

"*promoting the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources*" (Directive 2014/89/EU, art. 1). The Directive consists of four brief chapters and 17 articles in total (see Box 1). Along with the overall objective of the Directive, chapter 1 also defines what is meant by maritime spatial planning: *"'maritime spatial planning' means a process by which the relevant Member State's authorities analyse and organise human activities in marine areas to achieve ecological, economic and social objectives*" (Directive 2014/89/EU, art. 3). However short and ambiguous, this definition fits within the presented definition of MSP (on p. 22), indicating that the two processes are highly similar, if not the same (see Box 2).

BOX 1. Directive 2014/89/EU

Preconditions

Chapter I General provision

- Art. 1) Subject matter
- Art. 2) Scope
- Art. 3) Definitions

Chapter II Maritime Spatial Planning

- Art. 4) Establishment and implementation of maritime spatial planning
- Art. 5) Objectives of maritime spatial planning
- Art. 6) Minimum requirements for maritime spatial planning
- Art. 7) Land-sea interactions
- Art. 8) Setting-up of maritime spatial plans
- Art. 9) Public participation
- Art. 10) Data use and sharing
- Art. 11) Cooperation among Member States
- Art. 12) Cooperation with third countries

Chapter III Implementation

- Art. 13) Competent authorities
- Art. 14) Monitoring and reporting

Chapter IV Final provisions

- Art. 15) Transposition
- Art. 16) Entry into force
- Art. 17) Addresses

The body of the Directive, chapter 2, presents the framework of MSP in terms of its objectives and minimum requirements, for example. The key objectives, as presented in article 5 of the Directive, can be summarised as such:

> 1. Member States shall consider economic, social and environ-mental aspects to support sustainable development and growth in the maritime sector, applying an ecosystem-based approach, and to promote the coexistence of relevant activities and uses. (Directive 2014/89/EU, art. 5)
>
> 2. Member States shall aim to contribute to the sustainable development of energy sectors at sea, of maritime transport, and of the fisheries and aquaculture sectors, and to the preservation, protection and improvement of the environment, including resilience to climate change impacts. (Directive 2014/89/EU, art. 5)

The focus on sustainability persists from the overall objectives presented earlier in this chapter, with a broad connection to both economic and environmental objectives. The two objectives place strong emphasis on the development and growth of maritime economies while also including objectives for environmental protection and improvement. Another important element to art. 5 is the announcement that "*This Directive is without prejudice to the competence of Member States to determine how the different objectives are reflected and weight-*

BOX 2. Marine or maritime spatial planning?

With the formulation of the EU MSP Directive, the term was altered from being *marine* to *maritime* spatial planning. This version of the concept had already been used in the IMP, and it has been applied increasingly since the formulation of the two policies. Some use the term *marine* to emphasise the importance of environmental objectives, while others use *maritime* to emphasise the integrated and cross-sectoral aspect of MSP (Gilbert et al 2015). Others argue that it makes little difference which term you use, as they represent the same practice (Gee and Zaucha, 2019). Although the use of *maritime* spatial planning is growing, *marine* spatial planning is the original term and is still the most commonly used concept amongst researchers and in global MSP debates and is therefore the concept used predominantly in this dissertation (Gilbert et al 2015; Gee and Zaucha, 2019).

ed in their maritime spatial plan or plans." (Directive 2014/89/EU, art. 5), which leaves substantial room for manoeuvre for member states to formulate their own objectives. The framework for MSP laid out in chapter 2 of the Directive substantially mirrors the definition of MSP presented earlier, with an additional focus on cross-boundary collaboration among member states and third parties (Directive 2014/89/EU, art. 11 and 12.).

The fourth chapter of the Directive sets out the requirements relating to designating responsible authorities for the MSP practice and reporting the requirements of these authorities to the Commission. The last chapter sets out the requirements concerning the national transposition of the Directive. The Directive requires member states to have spatial plans in place for March 2021 at the latest, with a holistic, integrated and long-term plan for activities within national waters (Directive 2014/89/EU, art. 16). The spatial extent of these plans can be seen on Figure 3.

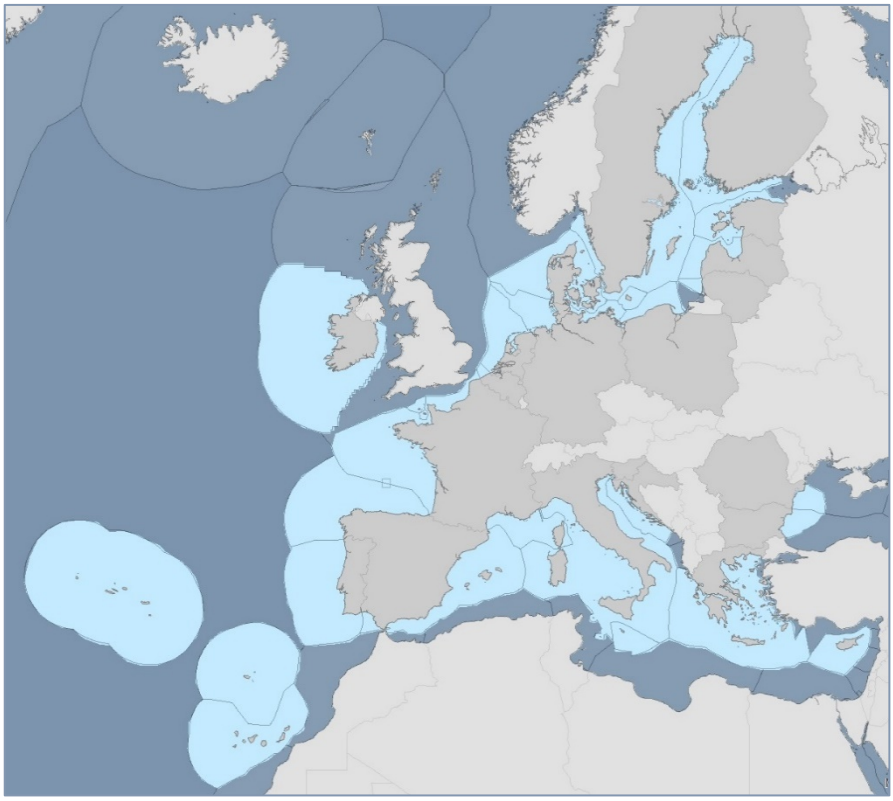


Figure 3 Countries obliged to have marine spatial plans in place by March 2021 (dark grey), and their Exclusive Economic Zones (light blue).

Marine spatial planning and sustainability

The current notion of sustainability was formed in the latter half of the twentieth century. However, thoughts of sustainability had already been formulated three hundred years earlier. One of the first to introduce this idea was the German forester, Hans Carl von Carlowitz (1645–1714), who was concerned about the state of deforestation and proclaimed that current generations should not live at the expense of future generations (World Ocean Review, 2015). More than two centuries after Carlowitz had raised awareness of the level of deforestation, the notion of sustainability was applied in a marine context. This was done by the German scientist Karl August Möbius (1825–1908), who was commissioned to study why oyster beds in Schleswig-Holstein had been exhausted. He explained the exhaustion of the oyster beds, *inter alia,* as linked to the increase in oyster markets and opted for governmental resource management by stating "*The preservation of oyster-beds is as much a question of statesmanship as the preservation of the forests.*" (Nyhart, 1998, p. 612; Laperche, Levratto and Uzunidis, 2012). Möbius proclaimed that only by determining the yearly amount of fishing by the growth rate would the oyster beds remain productive (Nyhart, 1998). This notion later led to the definition of the maximum sustainable yield (MSY) concept, which enables "*the maximum production of food from the sea on a sustained basis year after year.*" (Finley, 2011). The MSY concept has been used since the end of the Second World War and is still a central concept in fisheries management (Finley, 2011; FAO, 2016).

Over the last half a century, the use of the sustainability concept in marine settings has diversified tremendously (as presented in Box 3). In 1987, the Brundtland Report provided an explicit definition of 'sustainable development', which is today one of the most referenced definitions of sustainable development: "*Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own*" (Brundtland, 1987, art. 27). The focus of this definition of sustainability is on fulfilling human needs, thus shifting the original focus of sustainability debates, i.e. the concern for the overexploitation of natural capital such as forests (Brundtland, 1987). Originally, the main objective and meaning of 'sustainable development' was to improve living conditions in the developing world, while the Brundtland Report also states that development is restricted by the carrying capacity of nature and that humanity must adjust consumption patterns in order to adapt to these limits (Purvis, Mao and

BOX 3. Sustainability concepts in marine policies

With the growing number and diversity of activities connected to the sea, concepts of sustainability have become increasingly related to the management of maritime activities and marine ecosystems.

Concepts of sustainability in marine contexts were, for many years, limited to that of the maximum sustainable yield and the depletion of resources. During the last decades, the application and definitions of sustainability concepts have widened and concepts are now applied for various purposes within maritime sectors and marine management. In the EU's Integrated Maritime Policy (IMP), the purpose is to support sustainable development with a particular focus on creating blue growth, which is defined as "*economic growth based on different maritime sectors*" (European Commission, 2019). The sustainability focus of the IMP is thus primarily related to the notion of development and growth, particularly within maritime economies. With the establishment of the Marine Strategy Framework Directive (MSFD; Directive 2008/56/EC), the focus of the IMP on economic growth was supplemented by a sustainability focus on the use of natural resources. The MSP Directive further diversified the application of sustainability concepts with notions of sustainable co-existence, sustainable decision-making, sustainable management, sustainable tourism and sustainable extraction, in addition to those of sustainable development, sustainable growth and sustainable use.

Robinson, 2019). Consequently, the definition has been criticised for being a bad compromise between the need for nature conservation and aspirations for economic growth. As a result, the concept of sustainability has been widely debated during the last decades (Ott, Muraca and Baatz, 2011). From the framework proposed by the Brundtland Commission, which suggests the prioritisation of economic, environmental and social objectives equally, a perspective of sustainability developed that emphasises the interconnectedness of the three aspects (Moore, 2011). Around the turn of the century, the notion of a three-pillared or three-dimensional definition of sustainability dominated the sustainability discourse and is today a widely acknowledged and applied perception of sustainability (Giddings, Hopwood and O'Brien, 2002; Purvis, Mao and Robinson, 2019). At the same time as the three-pillared perspective was being developed, debates within the fields of economics and ecology focused on whether natural capital can be substituted by the two other capitals, social and economic (Moore, 2011). Advocates of what is referred to as 'weak sustainability' (or soft sustainability) argue that natural capital is largely exchangeable

and that the market regulates this exchange. This perspective entails the potential depletion of natural capital if there is a demand for it. Advocates of 'strong sustainability'(or hard sustainability), however, disagree with this idea of nature being a substitutable capital but argue instead that it is neither in the interest of current nor future generations if natural capital is depleted, which should therefore be avoided, even if it means a recession in other capitals (Ott, Muraca and Baatz, 2011). Consequently, if natural capital is depleted beyond a certain threshold, practicing a 'weak sustainability' perspective can result in the depletion of social and economic capital, which rely on natural capital (Santos *et al.*, 2014).

In 2015, the United Nations formulated a list of seventeen goals for sustainable development, which sets economic, social and environmental objectives for a global sustainable development. Of the seventeen goals, number fourteen aims at ensuring sustainability for life below water through a list of ten targets with related indicators. Other sustainable development goals (SDGs) relate either directly or indirectly to the ocean: SDG 13 aims to reduce the impacts of climate change, SDG 6 aims at ensuring clean water and sanitation and SDG 11 aims at creating sustainable cities and communities. The variety of focuses among the goals has brought a further nuance to the three-pillared conception of sustainability as it relates to various areas of nature and society (United Nations, 2018). The seventeen goals are today applied increasingly by organisations and industries, for example in corporate strategies (GRI, UN Global Compact and WBCSD, 2015).

The use of sustainability as a concept has increased and diversified significantly since the seventies. As exemplified by the MSPD, the word 'sustainable' is now connected to various objects and activities, such as 'sustainable decision-making' and 'sustainable tourism'. The increase in sustainability concepts and contexts they are used in has, unfortunately, led to an increased ambiguity and uncertainty in what a specific sustainability concept entails; even when defined, most definitions leave unanswered questions about what should be sustained and within which parameters (Brown *et al.*, 1987).

This dissertation explores the relationship between the practice of marine spatial planning and the concept of sustainability. While MSP is still a developing practice, research is increasingly focusing on exploring different aspects of MSP (see figure 4). As discussed in Box 2 (p. 26), *marine* spatial planning was the original term, and although *maritime* is used more often now, especially since the formulation of the MSPD in 2014, the original term is still used the most frequently.

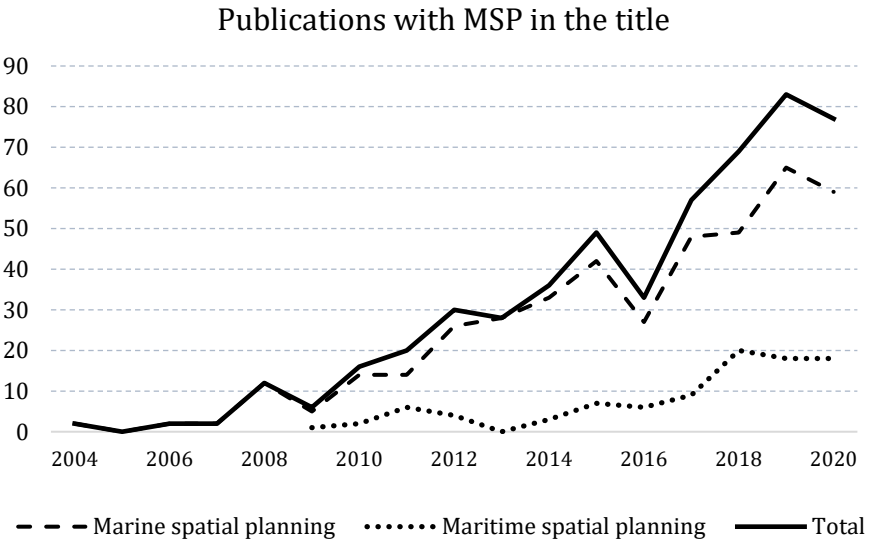


Figure 4 The development of new publications containing either 'marine spatial planning' or 'maritime spatial planning' in the title, and the sum of the two. Data from Scopus (Elsevier B.V., 2018).

Research has so far focused on various elements of the MSP process or key MSP activities (as presented in Figure 2, p. 24). These include research on stakeholder participation (Jarvis *et al.*, 2015; Strickland-Munro *et al.*, 2016; Flannery, Healy and Luna, 2018), the management of fisheries (Fock, 2008; Campbell *et al.*, 2014; Flannery *et al.*, 2016) and energy developments (Alexander *et al.*, 2012; Azzellino *et al.*, 2013) along with research on scenario building (Gimpel *et al.*, 2015; Outeiro *et al.*, 2015) impact assessments (Hammar *et al.*, 2020; Lonsdale *et al.*, 2020) and tools for MSP (Stelzenmüller *et al.*, 2013; Depellegrin *et al.*, 2017; Pınarbaşı *et al.*, 2017). While research has also focused on the practice of ecosystem-based management and what this entails within the MSP context (Crowder and Norse, 2008; Douvere, 2008; Gilliland and Laffoley, 2008), assessments of how marine spatial planning can plan for sustainable outcomes are limited. Although the concept of sustainability can be said to be young, compared to other concepts, it is today a popular concept both within and outside of academia (Moore, 2011). Since the turn of the century, the concept has been applied increasingly in scientific publications (see Figure 5).

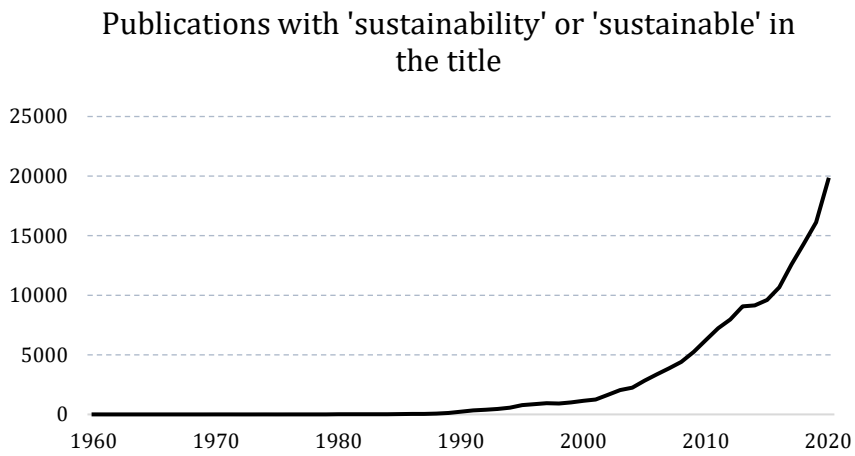


Figure 5 The development of publications with 'sustainability' or 'sustainable' in the title. Data from Scopus (Elsevier B.V., 2018)

Although the use of sustainability concepts has grown incrementally since the turn of the century, the number of publications focusing on the relationship between MSP and sustainability are limited (including: Santos *et al.*, 2014; Ntona and Morgera, 2018; Morf *et al.*, 2019; Kidd *et al.*, 2020). The first examples were published in 2013, around the time when the MSPD was being formulated by the European Commission (see Figure 6).

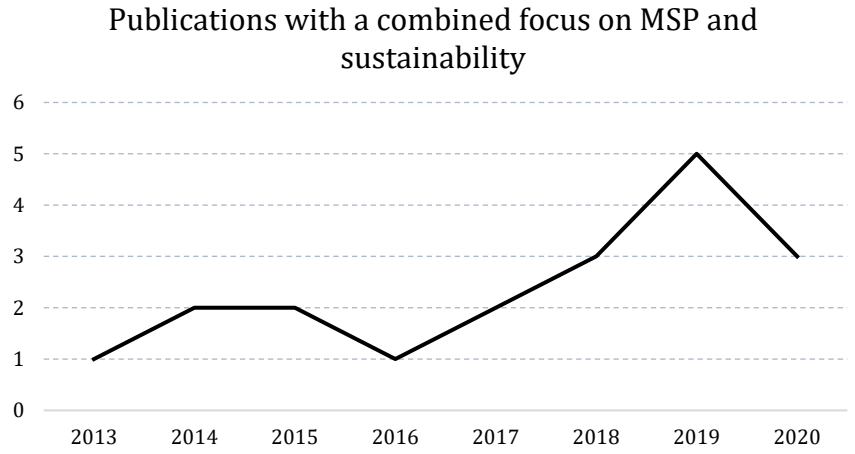


Figure 6 The development of publications with 'marine spatial planning' or 'maritime spatial planning' and 'sustainability' or 'sustainable' in the title. Data from Scopus (Elsevier B.V., 2018).

The objective of this dissertation is to facilitate an improvement of the current MSP practice by strengthening the existing research catalogue on the potential of MSP to achieve sustainability objectives. The connection between MSP and sustainability has been examined with a methodology and conceptual framework aimed at exploring the ability of MSP to plan for sustainability and conditions that might impede this achievement, with a focus on the influence of ambiguity in policy.

The dissertation consists of three main parts. Part I presents the research design, including the structure and content of the methodology and conceptual framework. Part II consists of a summary of each of the five dissertation papers. Part III collates and reflects upon the findings of the papers, which can be found at full length at the end of the dissertation, from p. 105 and onwards.

PART I
RESEARCH DESIGN

The development of the research design was guided by a genuine curiosity concerning MSP and the extent of its potential in planning for sustainability. Therefore, the research design was developed from an objective of learning more about the MSP practice and of understanding how this practice can help ensure sustainability at seas. Consequently, the following main research question has guided the development of the research design and the subsequent research:

How is marine spatial planning facilitating sustainability at sea?

This research question seeks to unravel the role of MSP in facilitating seas in a good environmental state that are able to support sustainable maritime activities. The word 'facilitate' indicates that MSP might not be able to ensure sustainability by itself but that it instead has a key supporting role, while this is debated later in the dissertation. The question was intentionally formulated broadly to ensure an open and explorative mind-set. This approach was taken due to the limited amount of published research on MSP and sustainability.

As the five papers of this dissertation brought new perspectives to the main research question, they all helped to strengthen the focus of the research scope and were each used to develop the scope of remaining paper(s). The development of each paper as such acted as an iterative process to build a more precise definition of the research scope. The following sections are dedicated to three elements of the research design: the research questions, conceptual framework, and methodology (se Figure 7).

First, the sub-questions of the main research question are presented, along with their purpose and interlinkages.

Second, the conceptual framework is presented, in which the focus is on the theoretical effects of ambiguity in policies and on why ambiguity can have constructive as well as destructive outcomes. It also builds a foundation for understanding how planners might perceive policies and how the individual planning culture can influence the planning process. This framework was developed based on initial findings of high levels of ambiguity in central MSP policies.

Last, the methodology is presented. This includes the main methods and data

sources as well as reflections on how the methodological choices, taken throughout the PhD project, have affected the project and learning outcomes.

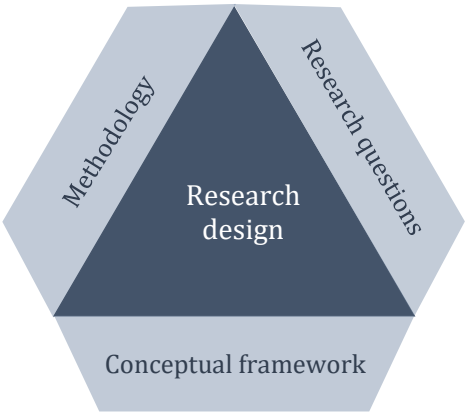


Figure 7 The presentation of the research design consists of three sections, i.e. Research questions, Conceptual framework and Methodology.

1. Research questions

As MSP is a relatively new practice, guided by newly formulated policies, the aim of this dissertation is to review the current practice of MSP and the influence of policies. While the research was guided by the overall research question, *How is marine spatial planning facilitating sustainability at sea*?, three sub-questions were formulated based on initial findings. The first sub-question (SQ) that was found necessary to answer the research question was:

SQ1: What is the potential role for MSP to facilitate sustainability at sea?

One way to consider how MSP facilitates sustainability at sea is to look at the guidelines and definitions of MSP and to identify its role in facilitating sustainable seas. While it is recognised that MSP might have a greater potential than what is current perceived to be within the scope of MSP, the word 'potential' emphasise the importance to consider both the perceived role and the potential role of MSP.

While the answer to SQ1 provides a conceptual understanding of how MSP can facilitate sustainability at sea, it offers no insight into the actual contribution of MSP. It enables a comparison of the potential role and the actual practice of MSP, which makes it possible to identify any constraining conditions that might prevent MSP from reaching its full potential. The comparison between the potential role and current practice of MSP is guided by the second sub-question:

> SQ2: How does current practice of MSP in the EU facilitate sustainability at sea, and does the current practice live up to the full potential of MSP?

Focusing on the practice of MSP within the EU, this question seeks to examine how member states practice MSP through an implementation of the MSPD. However, the diversity of practices found through initial assessments indicated a significant openness and diversity in MSP policy designs, which raised the question whether this ambiguity affects the prospect that MSP can facilitate sustainability at sea. The third sub-question therefore arose as:

> SQ3: How does policy ambiguity in EU and national MSP policy frameworks affect current practice of MSP?

The question of how policy ambiguity affects current practice was formulated with the intention of identifying both constructive and less-constructive outcomes of policy ambiguity.

Together, the three sub-questions aim at answering the main research question by focusing on central MSP policies and how these are implemented as this is essential in how MSP facilitates sustainability at sea.

2. Conceptual framework: Planning in an ocean of ambiguity

All spatial planning processes are highly dependent on communication and understanding, which are central elements to the linguistic world we live in, where perceptions and interpretations are taking place constantly. Concepts and formulations, especially ambiguous ones, are notoriously subject to different interpretations, which can affect the outcome of the communication process. The conceptual framework presented over the following pages has informed the research into the role of policy ambiguity and interpretation of concepts in MSP processes.

An inherent element of the planning practice is the interpretation of concepts

such as sustainability. A concept can be defined as "*words representing the meaning of synonyms which have been disambiguated from similar words with different meanings*" (Hjørland, 2010, p. 38). Ironically, the notion of a 'concept' is itself abstract and spans all fields of science as a ubiquitous element. As a result, there are many theoretical approaches to the notion of a concept. How we understand the idea of a 'concept' depends on our epistemological standpoint and, as a result, there is no consensus of what a concept is (Hjørland, 2009). However, the two concept theories of historicism and pragmatism have been found to bring useful perspectives on concepts. These were suggested by Hjørland (2009) to be the most fruitful perceptions to concept theory.

In a historicism view of concept theory, the emphasis is on the influence of time and on how concepts develop within cultural contexts. This perception was neatly formulated by the Danish philosopher, Søren Kierkegaard: "*Concepts, like individuals, have their histories, and are just as incapable of withstanding the ravages of time as are individuals.*" (Kierkegaard, 1983). From a historicism point of view, concepts are not only shaped by time but also by the discourses and epistemologies that exist throughout time. As defined by Hjørland (2010), the ideal of historic concept theory is "*To define concepts (a) genealogically and (b) by explicating their relations to theories and discourses"* (Hjørland, 2010, p. 39). Following the historic concept theory, concepts such as the sustainability concept are thus shaped by time and the discourses and epistemologies that have played a role in how the concept is understood today.

The pragmatism view is close to the historicism point of view in that both perspectives are highly focused on contextual conditions. As described by Hjørland (2009), pragmatism "*understands concepts as a way to fixate parts of reality in thought, language, and other symbolic systems*" (Hjørland, 2009, p. 1526). It focuses on the role of values and goals in the development of concepts and puts less focus on how concepts were previously perceived. As opposed to the retrospective historic view, the pragmatist view focuses on how a concept might develop and how it could be perceived and used in the future. It perceives the flexible nature of concepts and explores how concepts can be used in and adapted to different contexts, rather than how contexts shape concepts (Hjørland, 2009).

Used together, these two concept perspectives supplement each other well by having a backward- and forward-looking perspective on concepts. The pragmatist view gains from having a historic perspective as a point of departure. In this dissertation, both theoretical perspectives on concept theory are applied with the purpose of informing the evaluation of central concepts in MSP frameworks and what roles those concepts might play in the future. For central concepts studied in this dissertation, each concept has been examined in terms

of the origin and historical development of the concepts as well as how they are currently being perceived and applied. In addition, the future applicability and understanding of central concepts are reflected upon as well.

While the development of concepts is significant in how they influence planning processes, concepts are effective only through the human mind in which language is converted to meaning through interpretation. This conversion, from language to meaning, has been studied ever since humans became philosophical, from Lao Tse, to the ancient Greeks, to Nietzsche and is today still the subject of many studies (Ogden and Richards, 1989).

The generation of meaning consists of several stages (as illustrated in Figure 8). First, the communicated information has to be understood by the receiver. What is perceived through the eyes or ears is translated into something we can understand (Garcia Landa, 2015). Once the perceived information is understood, an infinite process of interpretation begins. Interpretation becomes more extensive the more complex the perceived information is. This means that when concepts and communications are perceived, interpretation becomes increasingly difficult the more complex the concept or perceived information is (Szostak, 2010). While the process of generating meaning through interpretation is continous and evolving, "*people are seldom very good at producing adequate definitions of terms that they are nonetheless competent to use*" (Rey, 1994).

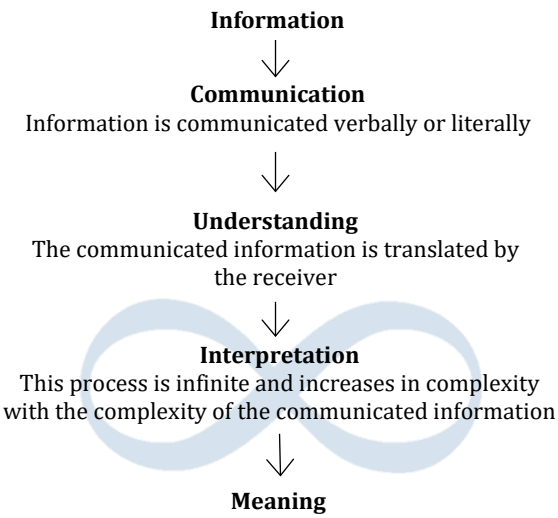


Figure 8 Illustration of the infinite process from information to meaning through understanding and interpretation in the human mind.

The study of Campbell and Marshall (2002) (in Box 4 below) shows how perceived information and concepts are interpreted differently, even among perceivers from the same academic background and practice. Within the practice of planning, such different perceptions could have a significant influence on the planning process and outcome, as an important part of the practice is to interpret political documents. As the theory presented previously indicates, the complexity of information, such as political documents, influences the meaning generated by the perceiver. The formulation of policies is therefore an inherent element to the conceptual framework.

2.1 Ambiguity in policy

While interpretation is an individual and infinite process, it gets more difficult as the complexity of the perceived information increases. When communication becomes complex, the message and meaning can be unclear to the perceiver, and one perceiver's interpretation might be substantially different from that of another perceiver. In this case, the communication can be said to involve a level

Box 4. Concepts in a planner's perspective

In a study of values and professional identities of planners, Campbell and Marshall (2002) held two focus group sessions with planners from different planning practices and with different levels of experience. While these planners largely agreed upon the value of planning, there were vast disagreements on what planning and its main objective was. While some suggested the purpose of planning was to *alter* the market, some claimed it was only possible for planning to *manage* the market. The younger planners were not as market oriented as the more experienced planners. They applied an environment-oriented narrative when defining the purpose of planning. In relation to this, the planners encountered great difficulty trying to define what 'protecting the environment' meant. The concept was used ambiguously by most planners, thus avoiding any specific and challenging questions. Another concept that had a prominent role in the focus group discussions was the concept of sustainable development: "*There were, however, major contradictions in the views expressed both in relation to the meaning of 'sustainability' and its implications for planning policy*." (Campbell and Marshall, 2002). The conflict between the planners over what the concept of sustainability meant might have been influenced by the perceptions of their professional identity, which the authors found to be just as unclear. The uncertainty of their identity as planners could stem from developments within planning, which have significantly altered the practice over the last couple of decades (Campbell and Marshall, 2002).

of ambiguity, here defined as '*the existence of two or more equally plausible interpretation possibilities*' (Dewulf *et al.*, 2005, p. 115).

Ambiguity is both inherent and essential in communication processes. Few communications are completely free of ambiguity; however, when perceivers of the same information reach a different understanding, ambiguity can be the cause of disputes and conflicts. Often, ambiguity is not recognised but is instead mistaken for incomplete knowledge (Floor, van Koppen and van Tatenhove, 2019).

In policy processes, ambiguity is often used intentionally with a strategic purpose (Jegen and Mérand, 2014). In the words of Deborah Stone (2012): "*Without it* (ambiguity)*, cooperation and compromise would be far more difficult, if not impossible".* Keeping a policy open to different interpretations can bring parties together that might otherwise have disagreed on the wording of the policy. The notion of 'constructive ambiguity' was defined by the American political scientist, Henry Kissinger, as '*the deliberate use of ambiguous language in a sensitive issue in order to advance some political purpose*' (Berridge and James, 2003). An example of constructive ambiguity can be seen in a study of ecological indicators, where Turnhout et al (2007) found that *"a certain amount of vagueness or ambiguity may contribute to the success of an ecological indicator in a specific context, because that leaves room for negotiation and reformulation*." (Turnhout, Hisschemöller and Eijsackers, 2007, p. 225). If ecological indicators were too quantitative or specific, they were found to be less successful due to the lack of negotiation space ensured by ambiguity (Turnhout, Hisschemöller and Eijsackers, 2007). While the deliberate use of ambiguity has been found constructive in settling disputes over sensitive issues, ambiguity is also used for leaving future options open, which might be particularly useful when formulating policies for new management areas such as MSP (Jönsson, 2016).

Policy ambiguity can be found in both policy goals and policy means. While policy goals are defined objectives or end-targets, policy means are actions that enable the fulfilment of policy goals. In practice, these can be economic incentives, such as grants, charges and fees for use, access and licenses, or non-economic incentives, such as regulations, support and information (Ehler and Douvere, 2009). The level of ambiguity directly affects the policy implementation process, as the openness leaves room for local factors to influence the process. Having ambiguously formulated goals also decreases the evaluation opportunities, as it becomes unclear on which parameters to evaluate the success of the implemented policy (Matland, 1995). In this regard, ambiguous policy goals are moving targets that change with every interpretation instead of offering a standard for evaluations, and naturally the means to reach the target change along with it (Stone, 2012; Rilov *et al.*, 2020).

Ambiguity in policies influences the implementation process differently, depending on whether the level of ambiguity and conflict is high or low. In a matrix of high and low levels of ambiguity and conflict in policy-making, Matland (1995) presents four different types of implementations. As initial assessments of this dissertation found high levels of ambiguity in MSP policies, the focus of the conceptual framework is on the two types of implementations caused by high levels of ambiguity.

In cases where the level of policy ambiguity is high, Matland (1995) describes two types of policy implementation; a *symbolic* and an *experimental* implementation. A symbolic implementation takes place when high levels of ambiguity and conflict are present. The implementation outcome is expected to vary greatly from site to site, as it largely depends on the strength of involved actors. However, the implementation of symbolic policies has often led to limited actual effects, even though the policy initially may have received substantial attention. In situations of high ambiguity and low levels of conflict, an experimental implementation can take place in which the outcome greatly depends on the contextual conditions and the actors involved in the implementation process. The outcome of an experimental implementation also varies greatly from site to site, and the implementation involves the risk of actors taking advantage of ambiguously formulated goals or means for the purpose of pursuing their own agendas, which can be far from, or even contradictory to, society's interest. Experimental implementations offer a great learning potential that can be achieved if experiences are evaluated and reflected upon systematically (Matland, 1995).

The formulation of policy goals and means are part of the policy formulation process, which ultimately influences the policy implementation process and the policy outcome. In their four-staged model of integrated policy implementation, Winter and Nielsen (2008) elaborate on the interactions and influence of the policy formulation process, the policy design and the implementation process on the implementation results (see Figure 9). In the *policy formulation process*, policy actors come together to negotiate and formulate a policy. Conflicts within this process often result in ambiguous goals and are likely to continue causing problems in the policy design and implementation process. Ambiguously formulated policies are likely to be implemented without a shared understanding of their meaning among the formulating actors (Baier, March and Saetren, 1986).

The formulation of a policy has immense influence on the implementation and final outcome of the policy, although a clear and unambiguously formulated policy does not ensure a successful implementation and does not guarantee a match between the outcome and the objectives of the policy (Winter and Nielsen,

2008; Sander, 2018).

A *policy design* usually consists of policy goals and a designation of a governmental authority with the responsibility for managing the implementation process. It can also include the implementation budget and means for achieving policy goals (Winter and Nielsen, 2008; May, 2012).

In the EU, the policy formulation process pertaining to MSP took place in the European Commission, as the initiator of policy formulation processes in the EU, with the MSPD as resulting policy design. Later on, a second round of policy formulation was carried out, as each member state implemented the MSPD into national legislation, with resulting national policy designs. The MSP process itself can be seen as yet another policy formulation process, as in many countries, it results in a legal document. However, the planning process for making marine spatial plans can also be seen as an implementation of the MSPD and national policy designs. Whether it be considered a policy formulation or implementation process, MSP is inherently a planning process in which the level of ambiguity plays a significant role in determining the room for manoeuvre for the planning team.

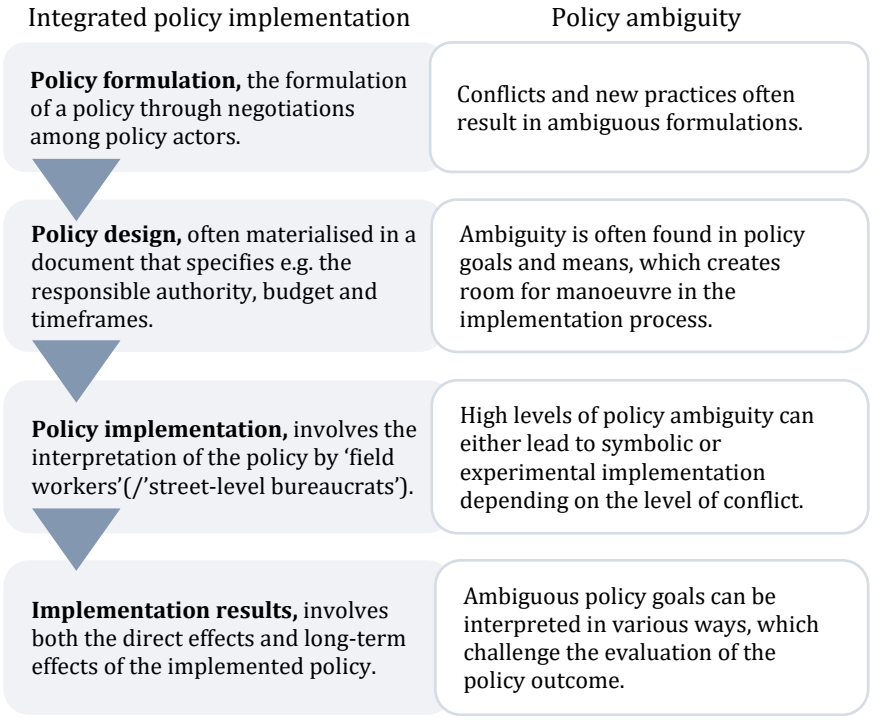


Figure 9 Policy ambiguity in integrated policy implementation. Inspired by the integrated implementation model of (Winter, 2012).

2.2 Planning in cultural contexts

The two types of implementation stemming from high levels of policy ambiguity, symbolic and experimental implementation, depend on local, contextual conditions as well as the competences and knowledge of the actors involved and implementation outcomes are therefore expected to vary from site to site (Matland, 1995). In the context of MSP, it therefore becomes inevitable that local planning cultures have a significant influence on the implementation outcome.

Being a social and interactive practice, planning involves objectives, values and norms, which are shaped by the local and professional cultural context (Othengrafen, 2010; Othengrafen and Reimer, 2013). Planning cultures can be seen as professional subcultures within societal cultures, i.e. they consist of both societal as well as professional values, norms and traditions. When it comes to traditions within MSP, these differ substantially between countries, as some have practised MSP for many years, while others have only started recently. MSP teams might, however, have traditions, values and norms from other planning practices, such as terrestrial planning. Thus, planning cultures within MSP teams are products of different planning practices and their development.

The study of planning culture has been fragmented and diverse in its definition of the concept of culture. Some studies have focused only on one part of planning culture, such as the administrative structure, while more intangible cultural aspects, such as beliefs, norms and traditions, have received less attention and have proven more challenging to analyse (Othengrafen and Reimer, 2013; Knieling and Othengrafen, 2015).

In a comparative evaluation of spatial planning systems in European countries conducted for the European Commission, the authors clarified the inherent role of ambiguity in planning systems: "*An important lesson we have learned in undertaking this project, is the difficulty of describing any system of spatial planning without some level of ambiguity*". In the process they had also found that "*there is scope for different interpretations of the meaning and significance of even the most carefully elaborated systems and policies*" (European Commission, 1997, p. 9). In the comparison of spatial planning systems, they found that member states have their own unique version of spatial planning and that no two systems are the same (European Commission, 1997). In the individual process of generating meaning through interpretation, as presented in Figure 8 (p. 39) cultural values can have a significant influence. The experiences, traditions, frameworks and tools applied by a planning team are likely to influence how the planners involved interpret certain information such as policy goals and means in the MSPD or national policy designs.

The presented theory suggests that planning practices, such as MSP, are highly dependent on dynamics situated earlier in the process, as illustrated in Figure 10. The level of policy ambiguity in the policy formulation process depends on the level of experience and conflict pertaining to the policy subject. Policy ambiguity then becomes inherent in policy goals and means, which are then interpreted by planners. The process of generating meaning from information (as presented in Figure 8, p. 39) not only takes place in the planning process, but is also an infinite process that takes place within every actor involved, from the formulation of the policy to the final MSP process and implementation. In addition, cultural conditions influence the interpretation of policies by the planners and thus the chosen approach to MSP.

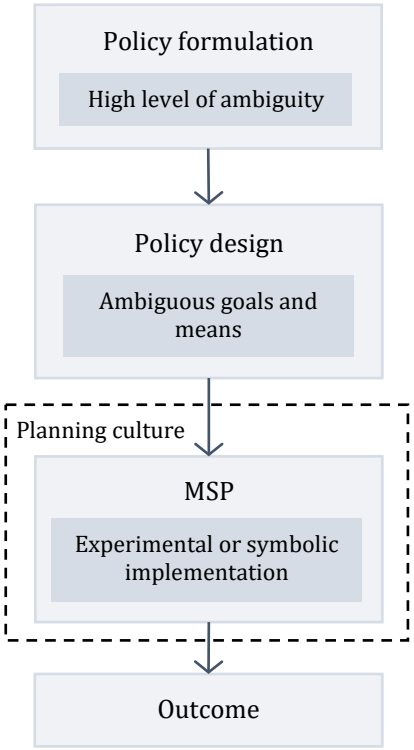


Figure 10 Conceptual model of the conceptual framework presented in the preceding sections. Each actor (present in the policy formulation and MSP process) goes through their own meaning generating process as presented in figure 8 (p. 39). While planning cultures also influence the other stages of this figure, their origin is with the practice of planners, which is why planning culture surrounding the MSP practice is highlighted in the figure.

The framework presented in Figure 10 suggests the assessments for sub-question 3 (*How does policy ambiguity in EU and national MSP policy frameworks affect the current practice of MSP?*) to find examples of experimental and/or symbolic implementations, if MSP policies are found to contain high levels of ambiguity, as indicated by initial assessments.

3. Methodology

An inherent and fundamental part of research is a perception of reality (ontology) and a perception of how to generate knowledge and how to study this reality (epistemology). The researcher can be fully conscious of these ontological and epistemological perceptions or they can play a less significant role. While some research has a solid theoretical foundation with a clear and explicit ontological and epistemological standpoint, other research is driven by the formulated research questions and a focus on finding explanations through a pragmatic approach (Bryman, 2016).

The research at hand largely began by following a pragmatic approach in order to explore different research scopes and to let initial findings guide the development of a conceptual framework. The development of the research design, including the conceptual framework, was carried out from an ontological standpoint close to objectivism. The oceans and its resources are part of a *real* world, as are the perceptions and knowledge of this world constructed in human minds. The epistemological standpoint can be categorised as critical realism, as defined by Roy Bhaskar (2008). As indicated by the *realism* element, critical realism supports an ontological view of the world as being real and independent of human perceptions, while it leans towards interpretivism rather than realism in its epistemological standpoint (Archer *et al.*, 1998; Toonen, 2013). In the analytical work of this dissertation, concerning planners' interpretations of policies, the interpretivism perspective was found to be ideal. It has supported the perception that knowledge is as real as the world it informs and can increasingly approximate reality and objectivity. However, while constructed in the human mind, interpretations and perceptions depend on the context in which they are shaped, as well as the world view of the perceiver, which can be shaped by values, assumptions and knowledge generated from previous experiences (Bhaskar, 2008).

As indicated by the *critical* element of critical realism, it is recognised that the generation of knowledge can never lead to a complete illustration of reality. This is particularly true when observing society and human behaviour, which is the case for this dissertation (Bhaskar, 2008). This view is strongly linked to the

conceptual framework as presented in earlier sections. It is not only related to how planners understand a certain concept or policy but also to the data-collection and interpretation carried out as part of this dissertation. Thus, while objectivity has been an aim throughout this research, it is acknowledged that research and knowledge are shaped by the viewer and interpreter. Later in this section, I elaborate on how my views as a researcher have influenced the conducted research. Below, the role of each paper in answering the research question is explained. This is followed by a presentation of applied methods and data sources and reflections on their role in answering the research questions. Detailed information about data collection methods and data sources is presented in the individual papers (see p. 105).

3.1 The role of the papers

Each of the three sub-questions has been answered through three papers (as illustrated in Figure 11). SQ1, on the potential role of MSP, was primarily answered with input from papers 1, 4 and 5, which all assess the potential of MSP from different angles. SQ2 was answered through papers 2, 3 and 4 as these are highly focused on examples of current MSP practices. SQ3 was primarily answered through papers 1, 2 and 3, which all address different ambiguities in MSP policies and how these are interpreted.

While it is clear from Figure 11 that the papers were not developed with the intention of answering one single sub-question, they focused on the role of policy ambiguity and on elements central to the MSP practice; taking an 'ecosystem-based approach' and the assessment of the collective pressure. Paper 1 (P1) played a significant role in the development of the conceptual framework, and the subsequent papers, as it explored the ambiguities concerning three interrelated concepts and showed that ambiguities pertaining to these concepts might have a direct impact on planning practices. P2 then went further into the planning practice and explored how policy ambiguity in the EU Directive on MSP has been transposed into national legislation and how it has been interpreted by planners. This assessment indicated that national practices vary tremendously, and P3, therefore, assessed the current practice of member states in assessing the collective pressure (an element of the MSPD), which has supported the findings of P2, having found substantially diverse practices. In order to evaluate the findings of the first three papers, P4 and P5 focused on building an understanding of what the potential of MSP is and how to develop a good practice.

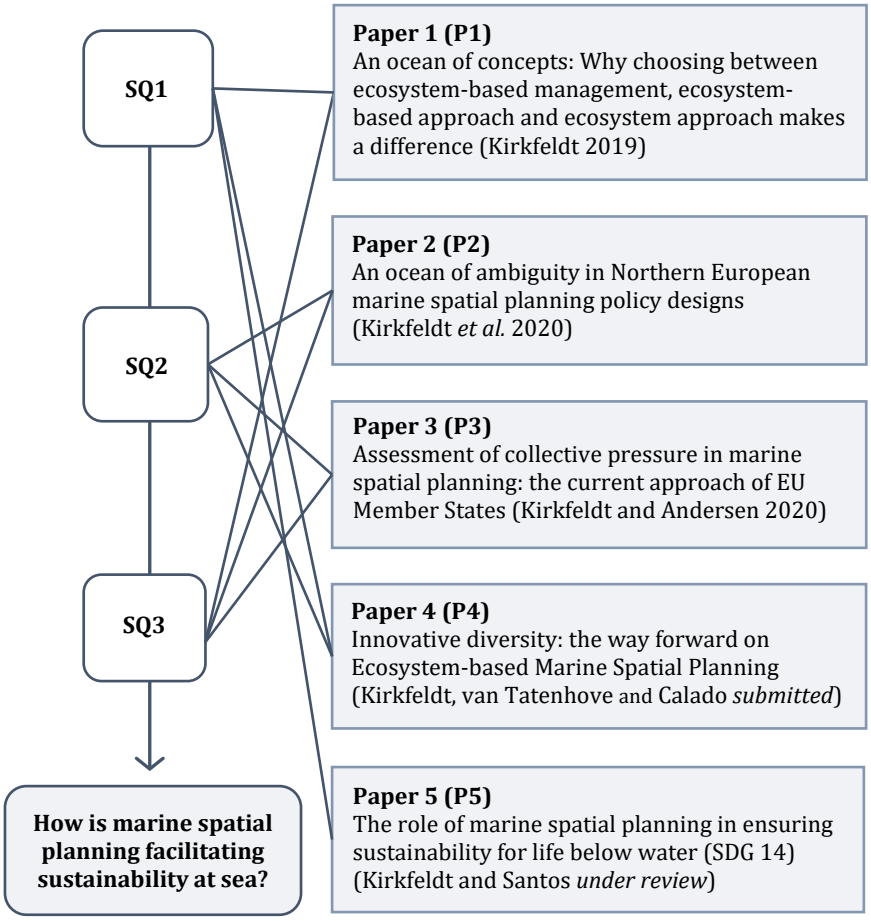


Figure 11 The role of each paper in answering the three sub-questions and thus the main research question.

3.2 Key data sources

For information on MSP practice, marine spatial plans and scientific literature on MSP have been the key sources of information. These have been used throughout the papers and dissertation; however, plans played a particularly important role in the assessments for papers 1 and 4, and scientific literature played a central analytical role in papers 1 and 5 (see Figure 12). In addition to literary sources, other assessments required more specialised knowledge in order to answer questions that could not be answered through document analysis. For instance, knowledge of how planning cultures affect the MSP practice was deemed more accessible through interviews with planners (for P2). In other cases, information

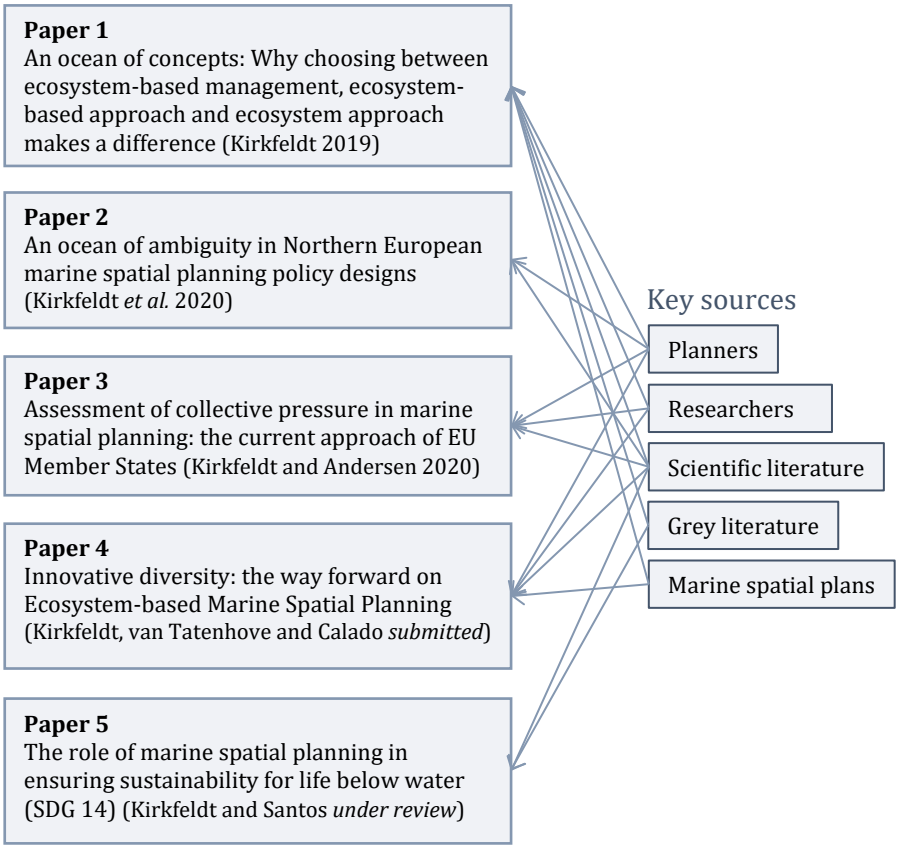


Figure 12 An illustration of the five papers and key sources of information applied for each paper. Detailed information about data sources is presented in the individual papers (see p. 105).

concerning the MSP process was not always provided to an adequate extent in marine spatial plans or other literary sources, and it was therefore necessary to go directly to the planners responsible in order to get a first-hand description of how the process was carried out. Central to all the papers have been the plans, the planner and the planning practice. Except for P5, which is entirely based on analysis of scientific and grey literature, all papers are based on data from plans and/or planners (see Figure 12). This focus has been intentional, as a key objective of the dissertation was to increase the understanding of MSP and get insights into the enabling and constraining conditions in this planning practice. In order to answer the overall research question, it was deemed more productive to focus on generating knowledge of the planner and the planning practice with key sources being the planners themselves and planning documents. Researchers, scientific literature and grey literature have played a key triangulating role in balancing the two planning sources, the plans and the planners. As illustrated in Figure 12, each paper has been supported by at least two sources of information. This information was made available and processed through a range of methods, as presented below.

3.3 Applied methods

Critical realism theory recognises that various types of knowledge exist, and that research benefits from accessing as many types as possible. It therefore supports mixed-methods research designs, which has also been an aim in the development of the research design presented here (Mingers, Mutch and Willcocks, 2013).

The methods used for this dissertation were selected in accordance with the scope of the research question, which is broad and focused on the effect of ambiguities in a new planning practice. The focus on EU legislation led to a geographical scope of 22-23 countries (the United Kingdom was still part of the EU at the beginning of the project). In other aspects of the dissertation (papers P1, P4 and P5), this geographical scope did not play a role, as the focus was on general MSP concepts and practices and aimed at collating MSP-related knowledge, no matter its geographical origin. The collection of information for an EU or global perspective suggested a geographically broad collection of data, which has predominantly been done by using literary sources and questionnaires. Due to the geographical scope of most of the papers, questionnaires have been used as the main method in several papers (P1, P3 and P4), as depicted in Figure 13.

While the geographical scope has been predominantly broad, a more geographically narrow focus was applied for paper P2. This was chosen in particular as the paper sought to go into more depth with the theoretical aspects

of the conceptual framework, especially in relation to the influence of planning cultures. Interview was chosen as an effective method for studying cultures and the perceptions of planners. Knowledge generated through interviews is seen as a crucial part of the dissertation, as it provides a more elaborate insight into the MSP practice than can be gained by other methods.

In total, 108 planners, researchers and consultants have contributed to the research of this dissertation, although a substantial overlap is expected between the respondent groups of the papers. The collected data has predominantly been processed through coding, as elaborated in the following section.

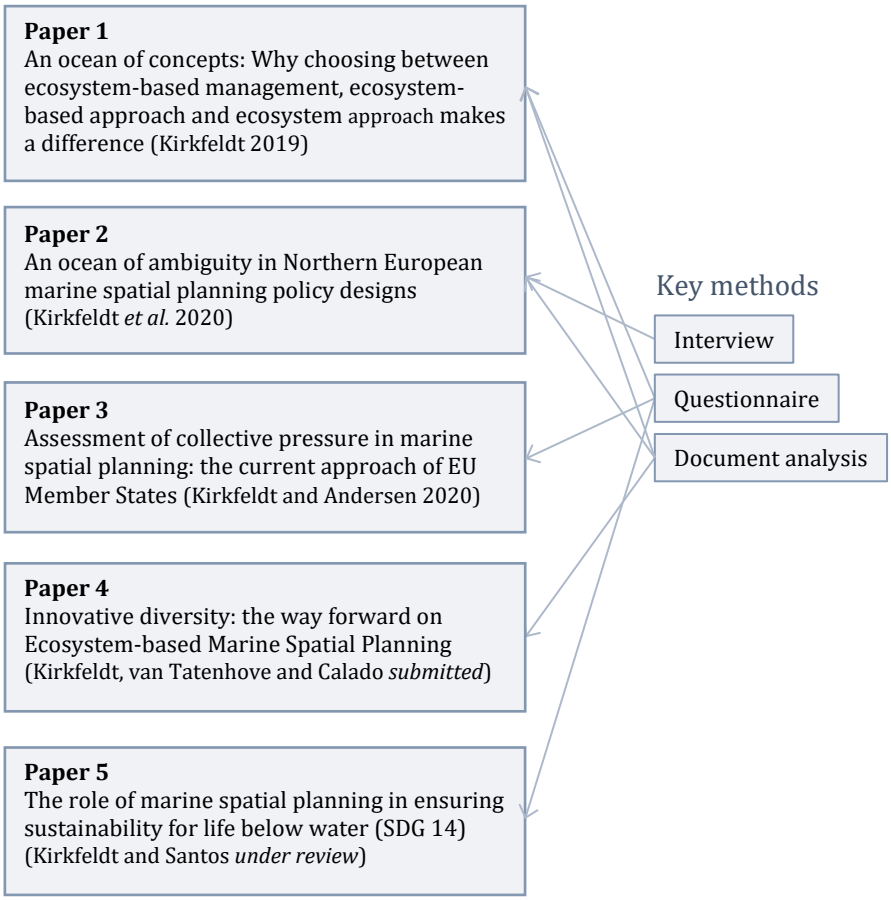


Figure 13 An illustration of the key methods applied for each of the five papers. Detailed information about data collection methods is presented in the individual papers (see p. 105).

3.3.1 Data analysis

Coding has been key to the processing of information from questionnaires (P1, P3, P4), interviews (P2) and documents (P1, P5). It is considered the best way to process substantial amounts of data in a systematic way, and it was predominantly used with the purpose of analysing and uncovering perceptions of the concept of MSP, EBA or challenges in the planning process. Most of the coding has been carried out using the Nvivo software. It was prioritised not to predefine any codes and instead to formulate codes based on the analysed data. Codes were thereby formulated as they occurred in the first round of coding and then used and verified in a second round. This double coding process has been supplemented, in all cases, with a separate assessment of the coded information, to compare interpretations of the non-processed information with the outcome of the coding process. Codes were thus viewed in isolation as part of the coding process as well as in context. The qualitative assessments of the processed data (interview transcriptions, questionnaires and documents) were aimed at strengthening the contextual understanding of the coding outcome as well as checking for additional and valuable information that was not found through the coding process.

3.4 Methodological reflections

While objectivity has been an aim in the data collection and analytical work conducted for this dissertation, it is impossible to be free of subjectivity and biases, especially in research that requires a high level of interpretation of qualitative data. The research questions have been shaped by a set of preconditioned notions, highly influenced by my scientific background, interests, knowledge, etc. However, as formulated by Toulmin (2003), these preconditioned notions are not only inevitable, but they also belong in scientific research, as long as they are flexible to change depending on the findings. For this dissertation, the research scope has been shaped by preconditioned notions pertaining to my scientific background and interest. Had my background and interests been different, the assessment of policy ambiguity in the MSPD could for example have focused on the participation and involvement of stakeholders or the decision-making process. Similarly, my background in planning entails an intrinsic interest in understanding the perceived problem from a planner's point of view and in having the planner and planning practice as a point of departure in the predominant part of the conducted research. Preconditioned notions have thus played an important role in building the scope of the dissertation.

The methodological and theoretical choices taken throughout the project have likewise been influenced by me as a researcher (see Figure 14). For example,

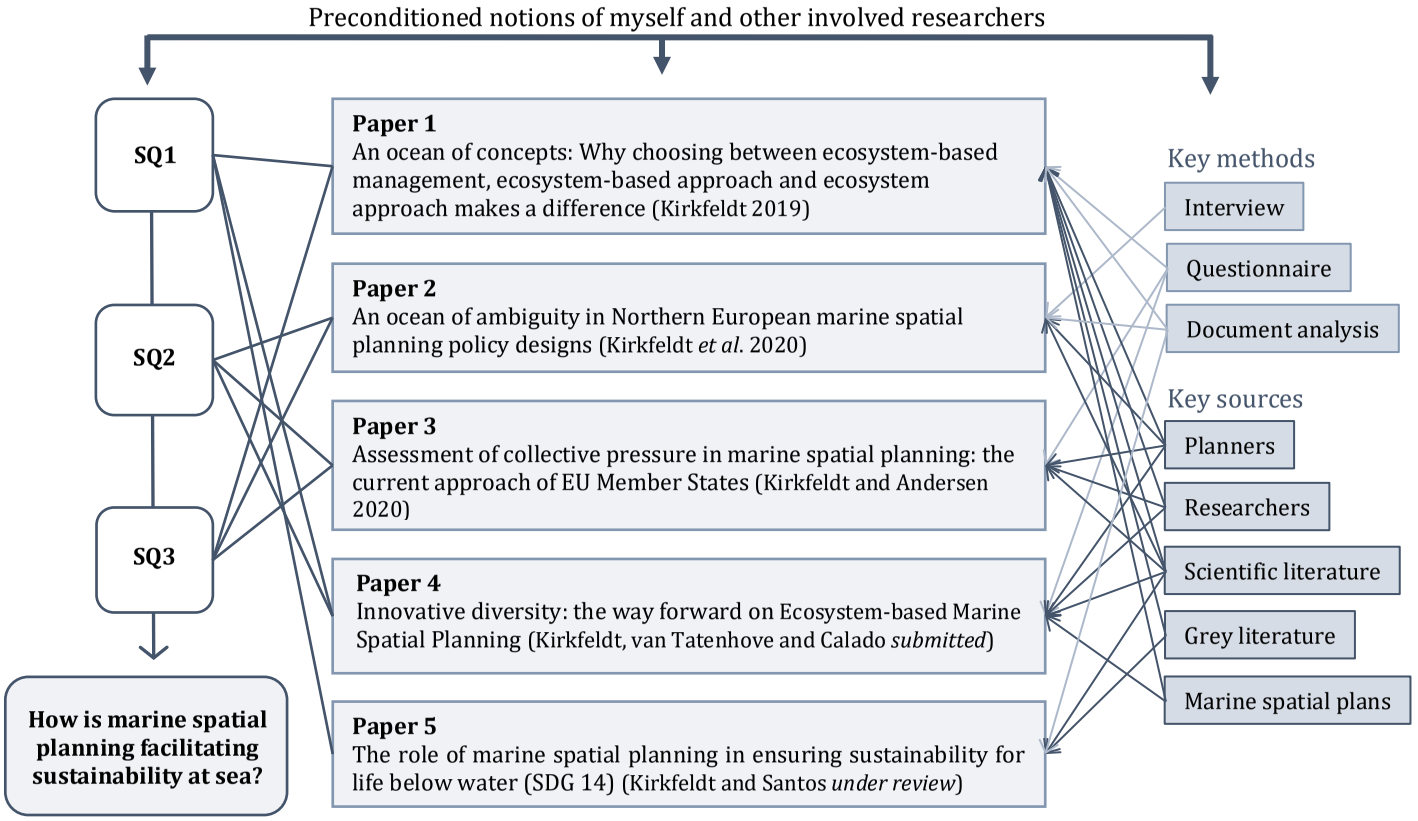


Figure 14 A combined illustration of the role of each paper in answering the research questions as well as the applied sources of information and methods for each paper. All have been influenced by preconditioned notions of involved researchers and myself.

three of the papers rely on questionnaires as the main method of data collection, while only one paper relies on interviews. This choice has likely been driven by a personal preference for questionnaires above interviews. Personal interests have as well influenced the construction of the conceptual framework, as this has been guided by a curiosity for how people interpret and understand information.

Potential biases have been sought to be reduced by having a mixed-method research design, by disclosing methodological choices, approaches and data, and by involving other researchers (e.g. co-authors from different fields of science) (see Figure 14). Having more researchers involved in the conducted research has shown to be a good way of challenging preconditioned notions among all involved through scientific debate, supervision and peer-review. This is seen as a crucial and effective way of strengthening the validity of the conducted research.

PART II
SUMMARY OF PAPERS

The following pages present a short summary of each of the five papers that have provided the fundamental research for this dissertation. The papers are presented in terms of their main objective, approach and key findings as well as their contribution to the dissertation. The papers can be found in full length from page 105.

Paper 1

Reference: (Kirkfeldt, 2019)

Title

An ocean of concepts: Why choosing between ecosystem-based management, ecosystem-based approach and ecosystem approach makes a difference

Author

Trine Skovgaard Kirkfeldt

Main objective

The main objective of the paper is to reduce the level of ambiguity pertaining to the 'ecosystem-based approach' and to establish how the concept relates to other concepts with a similar wording, which are often used interchangeably, i.e. 'ecosystem-based management' and 'ecosystem approach'.

Approach

Concepts with similar wording and meaning as the 'ecosystem-based approach' were located through a literature search and the coding of documents with definitions of management concepts pertaining to holistic marine planning practices and with the word 'ecosystem' included. Differences and similarities among the three most cited concepts were then assessed through a questionnaire, answered by MSP planners and experts.

Findings and contributions to the dissertation

From the list of concepts pertaining to holistic marine planning and containing the word 'ecosystem', the three concepts, 'ecosystem-based management', 'ecosystem-based approach' and 'ecosystem approach', are cited the most. The three concepts overlap in terms of main objectives and indicators; however, some differences exist, such as the aim for a good environmental status, which was only found in relation to the EBA concept. While the findings set EBA apart from the other two concepts, EBA is rarely defined, and, when defined, it is often done by referring to definitions for one of the other two concepts.

The findings contributed to the dissertation by providing insights into the sub-questions 1 and 3. For SQ1, on the potential role of MSP, the paper defines a central concept (EBA) in relation to how MSP facilitates sustainability. The paper also discovered a substantial level of ambiguity surrounding the three concepts, which inspired the development of the conceptual framework. As such, it gave insights into both the formulation of and answer to SQ3 on how policy ambiguity is affecting current MSP practice.

Paper 2

Reference: (Kirkfeldt *et al.*, 2020)

Title

An ocean of ambiguity in Northern European marine spatial planning policy designs

Authors

Trine Skovgaard Kirkfeldt, Jan P. M. van Tatenhove, Helle Nedergaard Nielsen and Sanne Vammen Larsen.

Main objective

The research conducted for this paper aims at answering the following research question, formulated for the paper: How do MSP policy designs vary in structure and in their framing of sustainability, and what understanding of sustainability have MSP planners created within this context? The intention of the paper is to assess three different MSP practices in terms of differences in national MSP policy designs, particularly those pertaining to the sustainability concept, as well as how planners perceive sustainability in relation to MSP.

Approach

Three policy designs, two from EU member states and one from a non-EU country, were assessed through a desk study. Three planners, one from each country, were then interviewed to validate the desk study and to assess the understanding of sustainability concepts among the three planners as well as how the local planning cultures influence national MSP practices and the perception of sustainability concepts of the planning team in charge of the MSP process.

Findings and contributions to the dissertation

The three national policy designs were found to be very different in terms of the framework they establish for the national MSP process. This was the case for the number and type of legal documents within each policy design as well as the type of responsible authority and the integration with other planning practices. The policy designs also varied in terms of the use of sustainability concepts as well as how these should be understood and implemented. The research found a general lack of definitions and guidelines for how to understand and implement sustainability concepts in the three national policy designs; however, the German policy design does define central sustainability concepts and offers some guidance for their implementation. The guidance and definitions of the policy design were reflected in the German planner's perception of the sustainability

concept, which was the most detailed of the three planners interviewed. This indicates the importance of having definitions and implementation guidelines included in policy designs, especially pertaining to ambiguous concepts such as sustainability.

The paper explored current practices of MSP and was thus an important step in answering sub-question 2. It also showed how the policy ambiguity of the MSPD and the ambiguity pertaining to the meaning of sustainability influence how planners understand sustainability, which supported the answer to sub-question 3 on the role of policy ambiguity.

Paper 3

Reference: (Kirkfeldt and Andersen, 2020)

Title

Assessment of collective pressure in marine spatial planning: The current approach of EU Member States

Authors

Trine Skovgaard Kirkfeldt and Jesper Harbo Andersen

Main objective

To assess the current practice of how collective pressure is evaluated through cumulative impact assessments by coastal EU member states, in order to examine how MSP units and policy designs are implementing the requirement to ensure collective pressures stay below a level compatible with a good environmental status.

Approach

Existing assessments of cumulative impacts in relation to MSP in the EU were located through a desk study. A questionnaire was then sent to at least one MSP unit in each member state, with the purpose of validating the desk study and obtaining information on how assessments are carried out.

Findings and contributions to the dissertation

The desk study found few examples of cumulative impact assessments for MSP practices, which was validated through the questionnaire. The lack of quantitative, modelled assessments of cumulative impacts can be explained, to some extent, by the lack of data and analytical tools. However, most member states address the task of cumulative impact assessments through strategic environmental assessments, which have been found by other research to assess cumulative impacts inadequately.

The paper mainly feeds into sub-question 2 by giving a review of the current practice pertaining to the assessment of collective pressure. By doing so, the paper also assessed central policy ambiguity in the MSPD and its influence on current practice and was, as such, an important element in answering sub-question 3.

Paper 4

Reference: (Kirkfeldt, van Tatenhove and Calado, *submitted*)

Title

Innovative diversity: the way forward on Ecosystem-based Marine Spatial Planning

Authors

Trine Skovgaard Kirkfeldt, Jan van Tatenhove and Helena Calado.

Main objective

To reduce the level of ambiguity pertaining to EBA, by mapping criteria for an efficient EBA and by finding similarities and differences among 'best practices', selected by MSP experts.

Approach

MSP experts were consulted through a questionnaire on their perceptions of what it means to 'take an ecosystem-based approach' and which cases they thought were good examples of this. The practices that were mentioned the most were then further assessed through a desk study in order to find similarities and differences and to compare the practices with the criteria for a good EBA, as suggested by the consulted MSP experts.

Findings and contributions to the dissertation

The research found the MSP experts have different perceptions of EBA. Criteria for EBA, suggested by the experts, were collated and discussed. Eight of the national 'best practices' were elaborated and compared with the list of EBA criteria, and they were found to vary considerably on many parameters except one - they were all innovative practices, with EBA being practiced in a new way.

The findings gave insights into the potential of MSP by examining 'best cases', and, thus, it supports the answer to sub-question 1. It also investigated previous and recent/ongoing MSP practices, and it therefore supplements the answer to sub-question 2 in addition to sub-question 1, on the current practice and potential of MSP, respectively.

Paper 5

Reference: (Kirkfeldt and Santos, *under review*)

Title

A review of sustainability concepts in Marine Spatial Planning and the potential to supporting the UN SDG 14

Authors

Trine Skovgaard Kirkfeldt and Catarina Frazão Santos.

Main objective

To establish a representative definition of MSP and to assess its potential in supporting the achievement of UN Sustainable Development Goal 14.

Approach

The most cited publications related to MSP were selected for a coding process from which a common definition of MSP was collated from definitions found in the coded documents. The main MSP activities and purposes were also located, and these were used in the comparison of the potential of MSP practice and the targets and indicators of SDG 14.

Findings and contributions to the dissertation

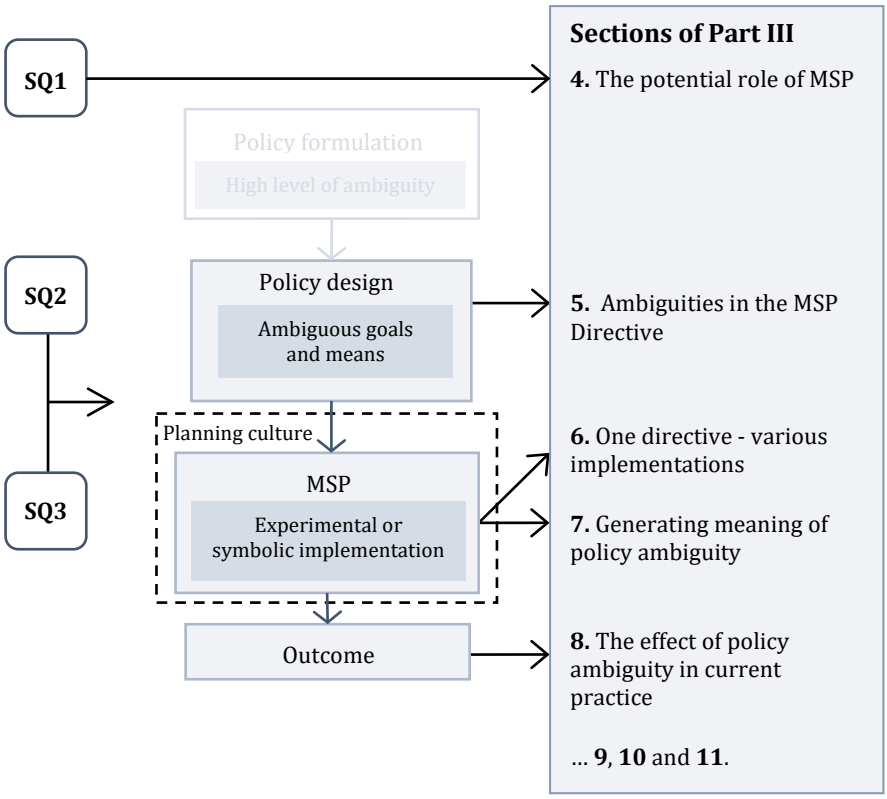
The coding process resulted in a representative definition and purpose for MSP as well as activities to be managed through MSP (as presented on pp. 21-24). The assessment of how MSP can contribute to the achievement of SDG 14 found a great potential, as MSP is capable of influencing most of the SDG 14 targets effectively, in particular through the establishment of Marine Protected Areas and restriction zones for fishing.

The generated definition and list of MSP activities and purposes showed what the perceived potential of MSP is. The subsequent assessment of what role MSP can play in achieving SDG 14 further explored the potential of MSP in achieving sustainability. As such, the paper gave substantial support to the answer to sub-question 1.

PART III
RESEARCH FINDINGS AND DISCUSSIONS

The five papers have all played a role in answering the research question, and have done so by providing answers for one or more of the sub-questions. In this part of the dissertation, the findings of the papers are collated in order to support further reflections on each of the three sub-questions. The next sections reflect upon and discuss the findings of the papers in relation to the central themes of the sub-questions. These sections are followed by the final conclusion and closing remarks of the dissertation.

As the first sub-question aims to define MSP and its potential in achieving sustainability objectives, the question has partly been addressed through the presentation of MSP practice in the introduction on pp. 21-27. After a short reflection on SQ1, this part of the dissertation is therefore mainly dedicated to sub-questions 2 and 3 (see Figure 15). While the current practice and the role of ambiguity are intertwined and have been assessed jointly in the papers, they are as well addressed collectively over the following pages. The current practice of MSP and the effect of policy ambiguity are assessed by following the process of the conceptual model, as presented on pp. 37-46, with a particular focus on the policy design, the implementation and the outcome of MSP. The themes for the next sections (on the right in Figure 15) are derived from the conceptual model and were chosen based on the findings of the five papers. Together, the assessment of the potential, the current practice and the influence of policy ambiguity aim to answer the main research question, *How is marine spatial planning facilitating sustainability at sea*?



SQ1: What is the **potential role** for MSP to facilitate sustainability at sea?

SQ2: How does **current practice** of MSP in the EU facilitate sustainability at sea, and does the current practice live up to the full potential of MSP?

SQ3: How does **policy ambiguity** in EU and national MSP frameworks affect current practice of MSP?

Figure 15 The sections of this Part III of the dissertation and how they relate to the conceptual model presented on pp. 37-46, and the three sub-questions. The five sections are followed by the conclusion, recommendations and perspectives in sections 9, 10 and 11.

4. The potential role of MSP

The potential role of MSP to facilitate sustainability was assessed primarily through Paper 5 (P5) (Kirkfeldt and Santos *under review*), in which MSP was defined through the activities it can address and the purposes it aims to accomplish (as presented in the introduction to MSP, pp. 21-27). MSP was found to be a complex practice, which can address a long list of maritime activities in order to accomplish a list of purposes, including the management of user-user and user-environment conflicts as well as the achievement of social, economic and environmental objectives (Kirkfeldt and Santos *under review*).

In addition to defining MSP, P5 also assessed to what extent MSP can play a role in achieving SDG 14. By comparing the potential of MSP to each of the 10 indicators of SDG 14, P5 found great potential for MSP to support the achievement of this goal, in particular through the establishment of MPAs and by restricting damaging fishing activities in certain areas. Both initiatives, MPAs and restriction zones, are relatively easy to implement, as they require no physical and very few management alterations. However, while fishing is one of the first relationships humans had to the oceans (see p. 15), this activity has had a long period with open access to ocean resources. The Cod Wars (see p. 19) are an example of how the exclusion of fishing fleets from a particular area can be highly contentious. However, while the cause of the Cod Wars was depleted fish stocks in Icelandic waters, this is still one of the main reasons to establish MPAs and restriction zones for fishing, as these can support the reestablishment of depleted fish stocks, not only within the MPA but outside as well. The arguments against MPAs and restriction zones have often been related to protecting the fishing industry from being excluded from their source of income, even though conservation measures could sustain their source of income on a long-term basis. However, as suggested by one of the consulted experts in P4 (Kirkfeldt, van Tatenhove and Calado *submitted*), a lack of political will can prevent environmental objectives from being prioritised over immediate economic objectives. Lack of political will to prioritise long-term objectives above short-term objectives could therefore prevent MSP from reaching its full potential.

While P5 found MSP to have great potential for facilitating sustainability, it also showed how the current practice and definition of MSP is entirely focused on the management of maritime activities. However, as the marine environment is largely impacted by activities on land, P5 also found suggestions that MSP can support the achievement of the SDG 14 through two initiates: "*Encourage and support full integration with terrestrial planning*" and "*Contribute to regulations for the amount of fertilizers and pesticides applied to agriculture*" (Kirkfeldt and

Santos *under review*). These initiatives suggest MSP could have a larger potential than what is currently considered within the scope of MSP. A key element of EBA, as suggested by the experts of P4 and key element in the MSPD (see Box 1, p. 25), is the consideration of land-sea interactions. However, while 'consideration' in itself does not necessarily involve any 'management' of impacts, current MSP frameworks define the scope of MSP to end at the coastline. It could however be argued that in order for MSP to be fully capable of ensuring sustainability, only managing activities at sea is inadequate.

From these perspectives, it can be concluded that the current perception of the role of MSP is that it can provide a solid framework, which enables the management of user-user and user-environment conflicts, and is able to facilitate sustainability, e.g. by establishing MPAs and by restricting the current level of damaging fishing activities. However, MSP is not currently perceived to be capable of ensuring sustainability for the oceans by itself while the effects of land-based activities are dominating in some areas. In order for MSP to ensure sustainable oceans by itself, it is necessary to extend beyond the marine space and to influence the management of all activities that have negative effects on the marine environment.

The potential of MSP acts as a point of departure for the assessment of current practice and the effect of policy ambiguity. It has therefore been a crucial step in order to answer the other two sub-questions, which are both addressed in the following sections.

5. Ambiguities in the MSP Directive

An important source of policy ambiguity is the policy design of the MSPD. Thus, to exemplify policy ambiguities related to MSP practice, central elements of the MSPD pertaining to the goal of sustainability are evaluated in the following. This is followed by a section with reflections on the different practices that are the result of the policy ambiguity and openness of the Directive.

The Directive has three correlated overall goals: "*This Directive establishes a framework for maritime spatial planning aimed at promoting* (1) *the sustainable growth of maritime economies*, (2) *the sustainable development of marine areas and* (3) *the sustainable use of marine resources*." (numbers inserted; Directive 2014/89/EU (Art. 1.1)). Other policy goals indicated in the Directive include 'sustainable co-existence', 'sustainable tourism' and 'sustainable extraction'. The central policy goals focus on the management of economic activities, however the Directive also includes policy goals focused on nature conservation: "*Member States shall aim to contribute* (…) *to the preservation, protection and improvement*

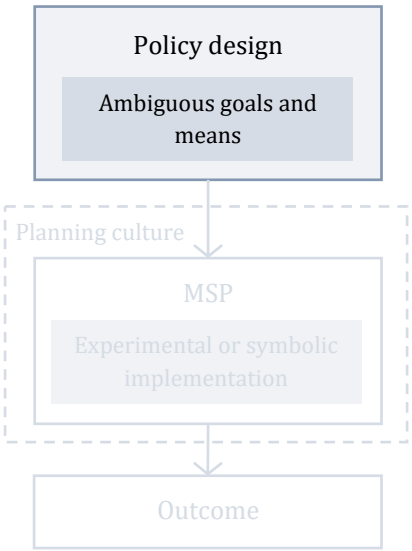


Figure 16 The focus of this section is on the policy design of the MSPD.

of the environment, including resilience to climate change impacts." (Directive 2014/89/EU (Art. 5.2)). The Directive can therefore be said to have a dichotomous objective, which, on the one hand, focuses on economic growth and, on the other hand, on nature conservation. However, while variations on the word 'sustainable' occur 26 times in the eleven pages of the Directive, the meaning is highly ambiguous in each context; for instance, what does sustainable co-existence mean?, what is sustainable use? and when is development or growth sustainable? These questions remain unanswered by the Directive, and it is therefore up to the reader to generate a meaning of these objectives.

The MSPD includes various suggestions on how the goal of sustainability could be reached; however, most of them remain unexplained and highly ambiguous. This is, to some degree, a deliberate decision taken in the policy formulation process, as the Directive clearly states: "*This Directive shall not interfere with Member States' competence to design and determine the format and content of that plan or those plans*." (Directive 2014/89/EU). Thus, it deliberately leaves room for manoeuvre for member states to interpret the Directive and develop their own frameworks for MSP, which has resulted in diverse practices (which are elaborated upon later in this chapter) (Kirkfeldt *et al.*, 2020).

One of the central concepts mentioned in the Directive is the 'ecosystem-based approach'. The Directive mentions this approach as a central step in achieving sustainability goals: "*In order to promote the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources, maritime spatial planning should apply an ecosystem-based approach*(…)" (Directive 2014/89/EU (14)). As a steppingstone towards achieving the policy goals, the ecosystem-based approach should be taken "(…)*with the aim of ensuring that the collective pressure of all activities is kept within levels compatible with the achievement of good environmental status*" (Directive 2014/89/EU (14)). While the 'ecosystem-based approach' is not thoroughly defined, the quote indicates that by taking this approach, the plan can support the achievement of a good environmental status by making sure collective pressures are not too high. However, it is still unclear in the Directive what 'taking an ecosystem-based approach' means, what collective pressures are and what a good environmental status is.

The EBA concept was more or less a new concept that was invented with the formulation of the MSPD. However, its formulation was similar to the already existing concepts of 'ecosystem-based management' (EBM) and 'ecosystem approach' (EA). The relationship between the three concepts was assessed in P1, which found that EBA is seldom defined and, when defined, it is often through a definition of EBM or EA. However, P1 also found differences in how the three concepts are defined and perceived (Kirkfeldt, 2019). By inventing a new concept (or a new version of an already existing concept), the Directive leaves it to politicians and civil servants to define and interpret the rules of the game, which ensures influence and responsibility for member states to generate their own interpretation of EBA.

The notion of 'collective pressure' is strongly linked to the practice of impact assessments and, more specifically, to cumulative impact assessments. Within this practice, there is conceptual muddling with similar concepts being used interchangeably, for example cumulative/combined/collective pressure/ impact/effect. Again, the Directive applies a relatively unused term[1], leaving the interpretation to member states, in addition to the task of building a framework for the assessment of 'collective pressure' (Kirkfeldt and Andersen, 2020). The aim to ensure that collective pressure stays below a level compatible with the achievement of a good environmental status connects an aspect of the MSPD

[1] A Scopus search for publications including "collective pressure*" in title, abstract or keywords, found 28 examples, most of which were published after the publication of the MSD. In comparison, Scopus found 2,765 publications on "cumulative impact*" and 13,792 on "cumulative effect*".

with a policy goal of another directive. Achieving a good environmental status is the key policy goal of the Marine Strategy Framework Directive (MSFD, Directive 2008/56/EC), in which it is defined as "*the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are intrinsically clean, healthy and productive, and the use of the marine environment is at a level that is sustainable* (…)". Once again, this concept was a new concept, building on an already existing concept, and this caused some debate as to how these concepts are related (Borja *et al.*, 2010, 2015). In this case, the concept of 'good ecological status' already existed and is a central policy goal of the Water Framework Directive (Directive 2000/60/EC) in which it was explicitly defined: *""Good ecological status" is the status of a body of surface water, so classified in accordance with Annex V*" (Directive 2000/60/EC). While it is not within the scope of this dissertation to assess the policy formulation process of the MSPD, reasons for why new concepts were used are unknown. However, potential reasons could be to formulate new concepts with no established frameworks and, thus, to use constructive ambiguity to bring together signatories who might otherwise have disagreed on the meaning and use of already established concepts.

The connection between the MSPD and the MSFD could suggest a collaboration between the responsible authorities for these practices if they are not already carried out by the same authority. While this is not suggested in the Directive, implementing the two directives in a way that is closely connected could have many benefits. In Paper 4 (Kirkfeldt, van Tatenhove and Calado *submitted*), the consulted experts found a close connection between MSP and the MSFD to be among the most important criteria for an efficient EBA. In line with this, Paper 3 concluded that a close connection between the two activities, by sharing knowledge, competences and other resources, would enhance both activities in their assessment of the collective pressures and, thus, in ensuring a good environmental status (Kirkfeldt and Andersen, 2020).

In addition to the ambiguities listed above, the Directive entails other formulations that can be interpreted differently. One example is the statement that "*Member States shall consider economic, social and environmental aspects to support sustainable development and growth in the maritime sector*" (Directive 2014/89/EU). Here, national policymakers are left with the task of defining which aspects to consider. Other ambiguities involve the use of the word 'shall' (cf. Felici, 2012) as well as conceptual ambiguities, e.g. related to the difference between maritime and marine spatial planning, as elaborated earlier in this dissertation (see Box 2, p. 26).

Of the ambiguities presented above, the policy goal of sustainability, the related concept of EBA and the assessment of the collective pressure are the

focus points of this dissertation. However, as the MSPD leaves significant room and responsibility for member states to develop their own way of performing MSP, the assessment of how EBA is practised, how collective pressures are assessed and how the goal for sustainability is reached, takes place within a context of widely diverse MSP practices. In order to understand the separate practices within MSP, the next section presents different aspects of how member states have interpreted and implemented the Directive.

6. One directive - various implementations

Being a relatively new practice, most of the current MSP processes are first attempts at developing marine spatial plans. There are few preceding examples of MSP to learn from and get inspired by when initiating a new MSP process and there is no one-size-fits-all solution for how to carry out MSP. This has led to a wide variety of MSP practices around the globe. In the EU, MSP practitioners are guided by the MSPD, which, in some respects could be expected to establish a level of uniformity among MSP practices. However, while some similarities exist, there are vast differences in how member states have approached the task of MSP. Each nation has built their own policy design based on their existing political system and based on the specificities of their marine areas and maritime economy. Although all seas and ecosystems are connected, coastal states have different maritime economies as well as different geophysical conditions, which necessitate different management measures. For instance, countries with shallow seas (such as Denmark, Germany, Belgium and the Netherlands) have good conditions for offshore wind farms, so this may be of higher priority in their MSP than for countries with deep seas. Some countries (such as the Mediterranean countries) have tourism industries strongly connected to the sea and might, therefore, have this industry and parameters related to it (such as a healthy and clean ocean) as a main priority. Geophysical conditions and national maritime economies as well as the existing political systems have all influenced the formulation of national policy designs for MSP.

In Paper 2 (Kirkfeldt *et al.*, 2020), three national policy formulation processes and policy designs were compared. It showed vast differences between the three policy designs. The comparison is supplemented here with aspects of policy designs from other member states. In P2, the policy designs of Germany, Denmark and Norway (not an EU member state) were compared in terms of the type and number of planning teams/authorities responsible for the planning process and the area coverage of the plans as well as the plan's legal influence.

These parameters are also the point of departure for the following evaluation of national practices.

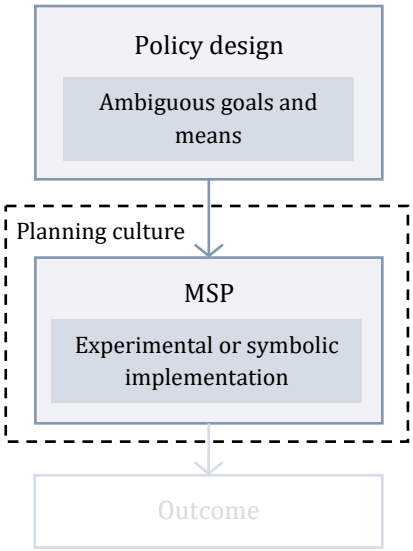


Figure 17 The focus of this chapter is on the implementation of the MSPD.

6.1 Responsible authorities

One of the first tasks set by the Directive was the assignment of a competent authority or authorities to carry out the task of MSP in each country (Directive 2014/89/EU, art. 13). The Directive does not specify any particular identity/area for the authority but stresses the importance of making such authorities known at an EU level to facilitate cooperation. The result is a wide palette of authorities (see Table 1) designated to carry out the MSP process. If these authorities are categorised into predominantly environmental, economic/other or physical planning authorities, roughly one third can be placed into each category. All these authorities have a different experience of planning practice. For instance, the responsible planning units for the German MSP process within the territorial waters have experience from terrestrial planning, having been in charge of planning on land before MSP was initiated. The Danish unit, however, had no ex-

Table 1. A division of MSP authorities in the EU, divided by the wording of the authority, with data from: (European MSP Platform (a), 2020).

Physical planning authority	
Bulgaria	Ministry of Regional Development and Public Works, Directorate General "Strategic Planning and Programmes for Regional Development", Executive Agency "Maritime Administration"
Croatia	Ministry of Construction and Physical Planning and the Croatian Institute for Spatial Development
Germany	Federal Ministry of the Interior, Building and Community; State Chancellery of the State Schleswig-Holstein; Ministry of Energy, Infrastructure and State Development (Mecklenburg-Vorpommern); Ministry of Food, Agriculture and Consumer Protection (Lower Saxony)
Ireland	The Department of Housing, Planning and Local Government
Malta	Planning Authority
the Netherlands	Ministry of Infrastructure and Water Management, Interdepartmental Directors' Consultative Body North Sea
Environmental authority	
Belgium	Minister for the North Sea, Marine Environment Service
Finland	Ministry of the Environment, National Maritime Spatial Planning Coordination Group
France	Ministry of Ecological and Inclusive Transition
Greece	Ministry of Environment and Energy, General Secretariat of Spatial Planning and Urban Environment - Directorate General of Spatial Planning - Directorate of Spatial Planning
Latvia	Ministry of Environmental Protection and Regional Development, Spatial Planning Department
Lithuania	Ministry of Environment
Spain	Ministry for Ecological Transition, General Directorate of Biodiversity and Environmental Quality
Sweden	Swedish Agency for Marine and Water Management, Marine Spatial Planning and Maritime Affairs
Economic/other authority	
Cyprus	Minister of Transport, Communications and Works (Department of Merchant Shipping)
Denmark	Ministry of Finance, Danish Maritime Authority
Estonia	Ministry of Finance
Italia	Ministry of Infrastructure and Transport
Poland	Ministry of Maritime Economy and Inland Navigation, Maritime offices
Portugal	Ministry of the Sea, Directorate General of Natural Resources, Safety and Maritime Services; Directorate General for Maritime Policy; Autonomous Region of Azores Directorate General for Maritime Affairs; Autonomous Region of Madeira Regional Directorate of the Sea
Romania	Minister of Regional Development and Public Administration General Department for Regional Development and Infrastructure

perience in spatial planning before initiating the national MSP process (Kirkfeldt *et al*., 2020). Whether old or new, each national MSP practice is embedded within societal and professional cultures, which inevitably ends up with diverse marine spatial plans. These cultures are not only affected by the national cultures but also by the type of responsible authority, for instance, in terms of the available knowledge, competences and planning instruments. In this respect, the various identities of the responsible authorities raise the question, are they equally capable of planning for the sustainability goals of the Directive? Are economic agencies as capable of assessing collective pressure and environmental status as environmental agencies? And are environmental agencies as capable of making spatial plans as physical planning agencies? Future research could investigate whether there are significant differences between the MSP practices carried out in economic, planning and environmental authorities.

6.2 Planning areas

In addition to the various identities of MSP authorities, the number of planning teams in charge also varies, whether in charge of one plan (such as the Netherlands, Denmark and Lithuania) or several geographically divided areas (such as Sweden), or whether several planning teams are in charge of different areas (such as France, Finland and Germany). In Germany, the MSP task is divided between the state (German Federal Ministry of the Interior, Building and Community) and the three coastal *Länder* (the states of Schleswig-Holstein, Mecklenburg-Vorpommern and Lower Saxony). While the state authority carries out the MSP process for the EEZ from 12 nm and beyond, the *Länder* establish integrated plans for their territorial waters (up to 12nm from shore)(Kirkfeldt *et al.*, 2020). Moreover, the size of the planning area naturally varies between each member state. While this would be expected due to the difference in size of the national EEZs (cf. Figure 3, p. 27), it influences the level of detail in the marine spatial plan. Member states such as Belgium, Latvia and Romania have small EEZs, which inevitably leads to a smaller demand for data and might entail fewer zones and activities to plan for, compared to Portugal, Ireland and Spain, for example, who have the largest EEZs in the EU (when not including Overseas Territories). Furthermore, not only the spatial extent but also the extent of activities and conflicts increases the demand for data. Future research could assess how the size of the planning area as well as other parameters affect the level of detail of the plan and the spatial assessments of collective pressure and the environmental status.

6.3 The legality of the plan

The Directive does not dictate whether the plans are to be legally binding. While most EU member states have chosen to make legally binding plans, in some countries, the plans are only partially binding (such as Germany) or they are only considered as guidance documents, as in the case of the Swedish plan (European MSP platform (b), 2020). In Denmark, the MSP process results in a new decree, which is depicted as a digital, interactive map, which is an unusual approach, as most processes result in written reports. While it is too soon to tell whether legally binding plans lead to the achievement of sustainability objectives more efficiently than guiding plans, future research could assess the success of legally versus non-legally binding marine spatial plans in implementing measures for a sustainable future.

6.4 Effect of different policy designs

While it can be argued that some of the differences in the national policy designs are minor and of little relevance when considering the final plans, other differences might have a significant influence on MSP practice. For instance, the type of authority chosen for the MSP task can have a significant influence, whether this is an economic, environmental or physical planning authority, and whether there is a tradition and culture of planning already within this authority, as was seen in Kirkfeldt *et al.* (2020). Indeed, the lack of experience and established planning culture can have both advantages and disadvantages, as it allows for creative and innovative solutions and approaches, while it might require more resources to carry out the planning process compared to a unit with a long planning tradition (Kirkfeldt, van Tatenhove and Calado *submitted*; Kirkfeldt *et al.*, 2020). If the national MSP policy designs and planning processes are seen as implementation of the MSPD, they are clear examples of what Matland (1995) classified as experimental implementations. As explained in section 2.1 (p. 42), experimental implementation can take place in cases where there are high levels of ambiguity, and is particularly driven by the actors involved and by contextual conditions, such as the planning cultures surrounding the MSP practice, which, to a large extent, depend on the type of planning authority (Matland, 1995; Stead, de Vries and Tasan-Kok, 2015). Matland (1995) also stresses that outcomes of an experimental implementation *"depend heavily on the resources and actors present in the micro implementing environment. These are likely to vary strongly from site to site, therefore broad variations in outcomes will occur*". While Matland suggests that experimental implementation can have both constructive and less-constructive outcomes, the effects of a diverse MSP practice in the EU are evaluated in the following sections.

7. Generating meaning of policy ambiguity

As laid out in section 2.1 (pp. 40-44) policy ambiguity is inherent to policy designs and can be found, *inter alia*, in policy goals. While ambiguous policy goals act as moving targets and reduce the opportunity for evaluation, the way to reach these goals changes according to how they are interpreted. Formulations in policies are prone to individual interpretations and can lead to experimental as well as symbolic implementation (see section 2.1, p. 42). The following sections explore how the MSPD's central policy ambiguities are interpreted and operationalised by actors in the MSP process.

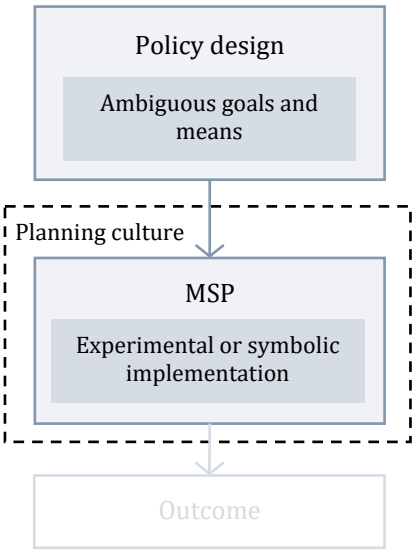


Figure 18 This chapter is mainly focused on how formulations in the policy design of the MSPD are interpreted in MSP practices.

7.1 Ambiguous goals: aiming for sustainable development

While the MSPD includes several policy goals aimed at sustainability, the research conducted in P5 demonstrated that sustainability is not commonly used in definitions of MSP. In fact, the assessment of 30 often referenced MSP definitions showed that 'sustainable' was the 95th most cited word (Kirkfeldt and Santos *under review*). In the P2 assessment of the Danish, German and Norwegian policy designs, the use of sustainability concepts was likewise found

to be significantly less than in the MSPD (Kirkfeldt *et al.*, 2020). Although sustainability was not found to be a concept commonly used in MSP definitions, the assessment of P5 found the three MSP purposes of 'sustain ecosystem services', 'support sustainable development' and 'manage activities more sustainably' to be among the key purposes cited in MSP definitions (Kirkfeldt and Santos *under review*). This indicates an inherent connection between MSP and the concept of sustainability.

In the assessment for P2, three planners were interviewed regarding their perceptions of the sustainability concept and of what sustainable MSP means. In the three cases, the reflections of the sustainability concept offered by the planners mirrored the focus on sustainability concepts in the national policy designs. Thus, if the policy design had clear definitions of sustainability and sustainability goals, so had the planner. However, while the German planner gave the most elaborate reflections on the sustainability concept, he also emphasised that the ambiguous and 'utopian' nature of the concept makes it less applicable, but that ambiguity also makes it broader and allows it to give meaning to more people (Kirkfeldt *et al.*, 2020).

As the sustainability concept is inherent to the MSPD, its meaning plays a significant role in the outcome of MSP. If the concept has no meaning to the reader, it could lead to either a lack of action or the formulation of objectives based on other agendas. A meaningless concept has little value in ensuring a good environmental status and the sustainable development of maritime economies. It is therefore important to ensure that sustainability concepts give meaning to the readers of MSP policy designs. An effective way of doing this is through explicit definitions and guidelines. While the findings of P2, along with the study of Campbell and Marshall (2002)(see Box 4, p. 40), suggest that some planners find little meaning in sustainability concepts, it could also be suggested ambiguous sustainability concepts be substituted with less ambiguous concepts or formulations, with similar meaning, which might give more meaning to planners.

7.2 The way to sustainability - through an ecosystem-based approach

While the MSPD suggests several ways of achieving sustainability, the one being evaluated in this dissertation is the 'ecosystem-based approach' (EBA). As described earlier in section 5 (p. 66), EBA is linked to the achievement of a good environmental status through the assessment and management of collective pressure.

The P1 assessment evaluated how MSP researchers and planners perceive the

EBA concept and found that, in literature, EBA is often defined by the two better established and older concepts of 'ecosystem-based management' (EBM) and 'ecosystem approach' (EA)(Kirkfeldt, 2019). However, the three concepts all lack clear definitions and, as a result, they are currently being implemented without a clear conceptualisation of strategy on how to operationalise them (Kirkfeldt, 2019). P1 showed how there is a substantial overlap between the three concepts but with a few differences, such as EBM being the only one connected to co-existence and EBA being the only concept with an aim for achieving a good environmental status. While EBA is often defined by references to EBM and EA "*the concept is seldom and sparsely defined*"(Kirkfeldt, 2019), and is usually used in connection to the MSPD without any definition. In the assessment for P4, respondents were asked for examples of concrete actions of an EBA. The response was a long list of criteria, most of which were only mentioned by one or two respondents; thus, respondents had different perceptions of what EBA entails. This further emphasises how ambiguity leads to various understandings of the EBA concept (Kirkfeldt, van Tatenhove and Calado *submitted*). P1 found similar ambiguities pertaining to the EBA concept and disagreements among MSP experts and planners on how to define this concept. Out of all the respondents, 66% thought this could have negative consequences, while some pointed to the risk of it leading to unclear objectives and outcomes (Kirkfeldt, 2019). Such outcomes could be the result of either an experimental implementation, in which policy ambiguity could be used to promote the agendas of the actors involved, or a symbolic implementation, in which the outcome could have little or no effect (see section 2.1. p. 42).

The findings of P1 showed how ambiguities pertaining to the EBA concept leave the task of interpreting and defining what the concept means to the planners in charge of each MSP process. As elaborated in section 2 and illustrated in Figure 8 (p. 39), the meaning of EBA is shaped through the ongoing interpretation of the actors involved. Thus, having a clear definition of EBA would not eliminate different perceptions of the concept. EBA will always be subject to interpretation, which will inevitably result in different perceptions. P1 and P4 both showed how the EBA concept is highly complex. As complex information leads to complex interpretation processes, it would be natural to expect EBA to have widely different interpretations (see section 2 p. 37). Consequently, reducing the current level of ambiguity concerning the concept of EBA can guide interpretation processes and shrink the span of interpretations, as it will then become less open and complex. One way of decreasing the level of ambiguity pertaining to EBA is through the formulation of more specific and operational guidelines, as requested by the consulted MSP experts in P4. Guidelines could for instance be formulated as part of a Common Implemen-

tation Strategy, such as the one developed for the MSFD (Kirkfeldt, van Tatenhove and Calado *submitted*). The P1 assessment also found a clear geographical difference in the use of concepts, which supports the theory of planning cultures as presented in section 2.2 (p. 44). Planners and researchers who favoured the EBM concept were predominantly located in North America, while the EBA concept is strongly connected to the EU and is therefore more frequently applied in European literature and marine spatial plans within the EU (Kirkfeldt, 2019). The preferred concept, whether EBA, EBM or EA, also influences the discourse concerning MSP practice. For instance, while the EBA concept was found to be the only one of the three with a connection to a good environmental status, in cultures who prefer EA and EBM, good environmental status, as defined in EU legislation, is less likely to be an objective of MSP (Kirkfeldt, 2019).

While providing a definition and overall perception of the EBA concept can be complex, perhaps diving into the elements of EBA makes it more concrete and applicable. The P3 findings would suggest this is not the case. In the evaluation of how member states assess collective pressure, respondents disagreed on the role of this assessment and on whether it ensures a good environmental status. There was, however, a general agreement that the assessment of collective pressure through the practice of a cumulative impact assessment is a necessary step for MSP to attain sustainability objectives, although it does not ensure a good environmental status in itself. The actual achievement of a good environmental status and the overall outcome of MSP depend on the actions of planners, policymakers and contractors, and on the achievements of other policies (Kirkfeldt and Andersen, 2020).

8. The effect of policy ambiguity on current practice

The five papers of this dissertation all evaluated aspects of MSP practice. Vast and extensive policy ambiguities in MSP policy designs were found to influence MSP practices in various ways, and findings showed how planners and MSP experts go through different interpretation processes, partly guided by local planning cultures and national policy designs, in order to generate meaning for sustainability objectives and perceptions on how to reach these objectives. The different interpretations are inevitably leading to diverse MSP practices, which have different outcomes and effects on the marine environment, coastal communities and maritime economies. With a focus on the outcome of MSP, this

chapter elaborates upon some of the effects of policy ambiguity and reflects upon ways to improve current practice (see Figure 19).

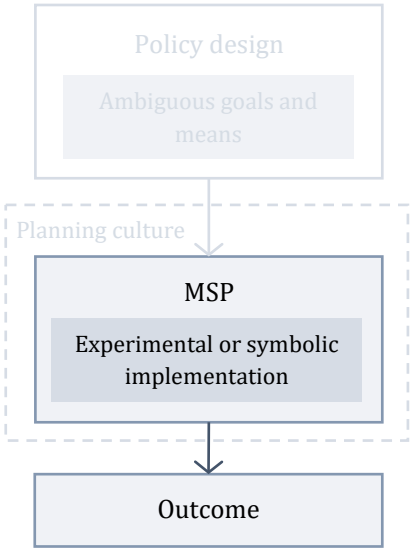


Figure 19 This chapter focuses on the outcomes of MSP and the role of policy ambiguity.

8.1 When constructive becomes destructive

The findings of P5 suggest that MSP has great potential for facilitating sustainability (Kirkfeldt and Santos *under review*). However, as presented in section 5 (p. 66) there is significant policy ambiguity in MSP policy designs, not least in the MSPD, and these ambiguities risk leading to unfortunate or destructive outcomes through either experimental or symbolic implementation.

As indicated in the preceding sections, there are currently various approaches to the practice of MSP. These approaches can be seen either as experimental or symbolic implementation of MSP policy designs, as high levels of policy ambiguity have been found. In P4, various examples of how to take an EBA in MSP are presented. These examples are widely different, with different objectives, political frameworks and applied planning tools; however, they were all seen as good EBA practices (Kirkfeldt, van Tatenhove and Calado *submitted*). While these practices are innovative, they can be seen as a form of experimental implementation, in which the planning teams have built their own frameworks and methodologies. While the risk in experimental implementation is that

ambiguity is exploited in the quest for achieving the agenda of the actors involved, potentially resulting in destructive outcomes, in the practices presented in P4, the outcome can be said to be productive. Constructive ambiguity had, in these cases, led to innovative approaches that have shaped and developed the practice of MSP with constructive outcomes.

While policy ambiguity can, in some cases, lead to experimental implementation with innovative practices and developments in planning practice, in other cases, it can lead to destructive outcomes or simply a lack of outcome through symbolic implementation. In the assessment of P3, the current practice of EU member states in assessing collective pressure was evaluated. This assessment showed clear lack of action. Assessments of collective pressures are few and sporadic and, in most cases, assessed as part of the strategic environmental assessment in the later stages of the MSP rather than as part of an EBA (Kirkfeldt and Andersen, 2020). As the assessment of collective pressure through cumulative impact assessments is a key element of EBA (Kirkfeldt, 2019; Kirkfeldt, van Tatenhove and Calado *submitted*), the majority of MSP practices in the EU were found not to be ecosystem-based (Kirkfeldt and Andersen, 2020). This conclusion supports the findings of a global assessment of MSP practices, conducted by Trouillet (2020), which likewise found that most MSP practices do not qualify as being ecosystem-based. This clearly indicates how experimental implementation can lead to less constructive outcomes, as the lack of an initial impact assessment of collective pressure can lead to destructive outcomes for the marine environment (Kirkfeldt and Andersen, 2020).

The lack of EBA practices in the EU can be the result of experimental implementation in which non-ecosystem-based agendas have steered the MSP process (Trouillet, 2020). The lack of assessments of collective pressure can also be an example of how policy ambiguity results in symbolic implementations. While the room for manoeuvre created by ambiguity can be used to invent innovative approaches or to direct the process according to one's own agenda, it can also be used in the practice of making the least effort with few changes to current management, i.e. a symbolic implementation. In P3, examples of symbolic implementation were found in the lack of collective pressure assessments. Most member states claimed these were assessed through the strategic environmental assessment (SEA), while the P3 assessment found limited and inadequate examples of assessments of collective pressure in the SEAs. Most marine spatial plans in the EU are therefore now implemented under the MSPD, with no assessment of collective pressure. Consequently, on paper the plans are presented as ecosystem-based plans in line with the Directive, while, in reality, EBA is a symbolic concept of the plan instead of an inherent foundation of the plan.

8.2 Constraining conditions and enabling opportunities for a better practice

The indications of both experimental and symbolic implementation, in which the outcomes have been both constructive and less-constructive, shows how there is a gap between the current practice of MSP and the potential of MSP, as presented on pp. 21-24 and pp. 65-66. While there are good examples of MSP with efficient EBA practices (see Kirkfeldt, van Tatenhove and Calado *submitted*), EBA is either lacking or insufficient in many cases. Consequently, there is room for improvement in MSP practice, and there are several ways to facilitate such improvement. One action would be to reduce the level of ambiguity in MSP policies with high levels of policy ambiguity. In the MSPD, the central policy goal of sustainability is used extensively, albeit without definitions for what it entails. Findings from the papers suggest that the excessive use of sustainability concepts in the Directive is not transposed, and that there is little support for the interpretation process of the planners in charge of MSP (Kirkfeldt *et al.*, 2020). While the German planner of P2 found the ambiguous nature of the sustainability concept to be an advantage, it could be argued that an excessive use of the concept blurs the interpretation process. This was indicated by the findings of Campbell and Marshall (2002), as presented in Box 4 (p. 40) in which planners disagreed on the meaning of the sustainability concept and its role in planning practices. While the historical development of the sustainability concept and the current use of the concept in the UN SDGs suggest a great value in the concept, its application increases the overall ambiguity of a policy if the concept is not properly defined. Thus, if the use of sustainability concepts in the MSPD were reduced, the overall level of ambiguity would likewise be reduced. Less ambiguous concepts or formulations could then be used as a replacement for sustainability concepts. For the central sustainability goals, ambiguity could be reduced by including definitions and supplementary guidelines for how to interpret the notion of sustainable management, sustainable development and sustainable use, for example, as exemplified by the German policy design assessed in P2 (Kirkfeldt *et al.*, 2020).

While some ambiguity can be reduced by reformulating policies, another approach, as suggested earlier, could be to supplement policies by guidelines for its interpretation and implementation. In P2, the Danish planner found it challenging to interpret the policies pertaining to MSP, as "*it is not clearly indicated in the Directive 'how-to-do'*"(Kirkfeldt *et al.*, 2020), which suggests guidelines on how to interpret MSP policies such as the MSPD could be helpful to planners. The survey conducted for P4 showed how most respondents found the number of general guidelines for the implementation of an EBA to be adequate,

while more location-specific and operational guidelines could be helpful (Kirkfeldt, van Tatenhove and Calado *submitted*). Another approach could be to develop a Common Implementation Strategy for the MSPD, as suggested by a respondent in P4. The implementation of other policies related to the MSPD, such as the MSFD and WFD, has been guided by Common Implementation Strategy documents, with more concrete and less ambiguous guidelines for its implementation (Kirkfeldt, van Tatenhove and Calado *submitted*).

Reducing the current level of ambiguity in MSP policies facilitates an improvement in current practice. However, constraining conditions in MSP practice, such as a lack of data and methodological tools, also plays a significant role in preventing MSP from meeting its full potential. In P3, the assessment of collective pressure was found to be lacking and inadequate, for which respondents pointed to a list of challenges. As the management of marine areas is still a relatively new practice, it often requires data that has not yet been generated. Most of this data is highly demanding and expensive to generate, and, as a result, it is often not produced. As one respondent in P4 formulated: "(…)*the practice* [ecosystem-based MSP] *requires quite a lot of data, which is generally still sparse for the marine areas.*" (Kirkfeldt, van Tatenhove and Calado *submitted*). Respondents in P3 pointed to the lack of data and challenges in data storage as a constraining condition in the assessment of collective pressure. They also pointed to challenges in data processing and analysis, such as a lack of knowledge on how pressures affect certain species and how pressures accumulate into synergistic impacts (Kirkfeldt and Andersen, 2020).

One way of addressing the lack of data or lack of resources for data generation could be to coordinate data-demanding activities related to different marine management efforts. The overlapping scope of the MSPD and MSFD is an ideal opportunity to share expensive data and data analysis, as the implementation of both requires substantial data and knowledge on ecosystem elements, the environmental status and geophysical conditions. Authorities responsible for the implementation of the two processes, which are rarely the same, could coordinate on the assessment of impacts, including collective pressure, thus reducing their individual costs. This could also ensure an impact assessment of higher quality compared to the quality if the two authorities had approached the task separately. A close coordination and joint assessment of the two practices would also benefit from combining competences and knowledge from both authorities. The research conducted for P3 showed how most member states have collaborations between the two units, while in Spain, the Netherlands, Ireland and Sweden there is one authority in charge of both MSP and the marine strategy. Collaborations between MSP and marine strategy units are currently taking place in connection with impact assessments, the mapping of activities

and stakeholder involvement through meetings and ongoing feedback. The importance of coordinating the two practices was emphasised by respondents for P4, who cited a close connection with other policies, such as the MSFD, as the most frequently mentioned EBA criteria (Kirkfeldt, van Tatenhove and Calado *submitted*). The Danish process is an example of how the two authorities might cooperate. The Danish planner, interviewed for P2, explained how the planning team had ongoing meetings and discussions with the agency in charge of the marine strategy, with the aim, *inter alia,* of discussing how EBA should be interpreted and implemented (Kirkfeldt *et al.*, 2020). It could be argued that the closest connection is ensured by having one authority responsible for the implementation of both directives; however, close connections can also be ensured though ongoing collaboration, as exemplified by the Danish planning process.

Another way of reducing the costs of data generation and analysis could be to engage in transboundary collaborations, thus enabling the advantage of economies of scale. In P4, respondents suggested several transboundary projects as 'best practices' of EBA. These projects included the Pan Baltic Scope, Adriplan and SIMWESTMED projects, which are examples of how several countries can benefit from transboundary collaboration, with the intention of generating new data and knowledge as well as developing already existing or new methodologies (for information on the projects, see Kirkfeldt and Andersen, 2020).

While the challenges presented here are substantial and complex, there are ways to reduce the constraining conditions of ambiguity as well as the need for more data, knowledge and methodologies. For MSP to reach its full potential, there is both a need to reduce policy ambiguity and to overcome constraining conditions in data, knowledge and methodology shortages.

9. Conclusion

In the preceding chapters, the five papers of this dissertation have been collated with the purpose of seeing the bigger picture and supporting further reflections that would contribute to answering the research question, *How is marine spatial planning facilitating sustainability at sea*? The present chapter presents the conclusions by answering each of the three sub-questions. It is followed by two sections that present a framework for how to ensure sustainability through MSP and future prospects for the oceans and MSP.

SQ1: What is the potential role for MSP to facilitate sustainability at sea?
The potential role of MSP to facilitate sustainability has primarily been assessed through the defined role of MSP as perceived by planners, researchers and policy makers. In addition, reflections on whether the potential role could be greater, than what is currently perceived to be within the scope of MSP, have also been presented.

The research conducted for this dissertation found MSP to have great potential for facilitating sustainability. While the aim to 'sustain ecosystem services' is among the top five purposes, MSP is particularly capable of facilitating sustainability by ensuring ecosystems are in a good environmental state through an ecosystem-based approach. Central to this is the assessment of collective pressure and the management of activities that prevent a good environmental status. In particular, MPAs and restriction zones for fishing were found to be efficient means for MSP to facilitate sustainability.

While the potential role of MSP to facilitate sustainability was found to be high, whether sustainability is ensured relies on other management activities, such as marine strategies, hence MSP is currently not perceived to be able to ensure sustainability by itself. The conducted research found one area where the perceived role of MSP is insufficient if sustainability objectives are to be achieved through MSP alone. In areas where land-based activities have severe impacts on the environmental status of the sea, ensuring a good environmental status would require a change in existing regulations for land-based activities, which is currently not perceived to be within the scope of MSP in common guidelines and definitions. The general perception of MSP sees the practice as a management tool for the spatial division of maritime activities with an influence limited to the management of maritime activities only. However, in order to ensure sustainable seas that enables further development of maritime activities, in many areas it is necessary not only to focus on maritime activities but also to engage in management efforts to reduce the negative impacts of land-based activities. Due to the interconnectedness of the oceans, it could also be argued that all MSP states should address the pressure from land-based activities in order to reduce the collective pressure not only in the EEZ of one nation but also in adjacent sea areas and areas beyond national jurisdiction.

While the management of land-based impacts is currently not considered within the scope of MSP, the conducted research found that MSP has greater potential for facilitating sustainability than is currently defined as the scope of MSP. The assessment of the role of MSP in achieving the UN SDG 14 (P5) showed how MSP is a largely versatile practice, and the assessment of best practices of ecosystem-based MSP (P4) showed how MSP can be practiced in various ways. Both papers show how MSP is a developing practice, and how new approaches

to MSP are taking shape continuously. Thus, if the ability of MSP to facilitate sustainability were to be strengthened, future practices could include the management of impacts from both land-based and maritime activities.

SQ2: How does current practice of MSP in the EU facilitate sustainability at sea, and does the current practice live up to the full potential of MSP?

The assessment of current practice showed a diverse picture of ways to approach the task of MSP. While some practices show efficient ways of facilitating sustainability through the practice of an 'ecosystem-based approach', other practices are less likely to facilitate sustainability. A list of factors challenges current practice of MSP and prevent it from reaching its full potential. These include a lack of analytical/technological tools, knowledge and data as well as an understanding of key concepts and aspects of MSP. For this dissertation, the focus has been on the influence of the latter challenge.

While it could be argued that for MSP to reach its full potential in facilitating sustainability, sustainability objectives need to be clearly defined and well understood by involved actors. However, while MSP was found closely linked to the concept of sustainability, not least in the MSPD, the conducted research showed how planners have widely different perceptions of what sustainability means for MSP. Planners who were supported by definitions and guidelines in policy designs, on how to understand sustainability, generally had a more elaborate understanding of sustainability concepts. The lack of understanding of the sustainability concept indicates either that the practice is aimed at other policy goals or that some MSP practices aim for undefined sustainability goals. Having unclear policy goals broadens the necessary policy means. As the research conducted for this dissertation found that not all national policy formulation processes focus on building a clear foundation for how planners should understand the sustainability concept, there is a need to have more clearly defined policy goals pertaining to sustainability.

Closely linked to the objective of sustainable development is the concept of EBA. The concept was used for the first time during the policy formulation process for the Integrated Maritime Policy (IMP), and has not been thoroughly defined in the IMP nor within the MSPD. It is therefore primarily defined by the two similar concepts, 'ecosystem-based management' and 'ecosystem approach', which has led to vast disagreements among planners and researchers on how these concepts relate to and differ from each other. While this dissertation showed how there are few but significant differences among the three concepts, it has also demonstrated that EBA is a highly versatile concept, which can be practiced in various ways. One objective shared by the three concepts was the objective of sustainability. In general, the best examples of ecosystem-based MSP

were found to be highly innovative and inventive in their approach to EBA.

Central to the practice of MSP, as well as the practice of EBA, is to ensure that collective pressure stays below a level compatible with a good environmental status. The research conducted for this dissertation showed how the current practice of assessing collective pressure is inadequate if a good environmental status is to be ensured. Few examples of cumulative impact assessments were found, and, in most cases, these were carried out as part of the strategic environmental assessment; thus, the assessment does not act as a foundation for the MSP process. The majority of MSP practices in the EU were found not to be ecosystem-based, and can therefore not be said to fulfil the full potential of MSP. While a lack of data and analytical tools form barriers and explain why this practice is inadequate, future investment in the generation of marine data and methodologies for the assessment of collective pressure would provide significant support for MSP processes in becoming ecosystem-based.

MSP currently facilitates sustainability by practicing an EBA. However, the findings of this dissertation have found few examples of MSP processes where EBA is practiced in a way that meets the full potential of MSP.

SQ3: How does policy ambiguity in EU and national MSP policy frameworks affect current practice of MSP?

The conceptual framework presented in section 2 (pp. 37-46) suggests MSP to be implemented through either experimental or symbolic implementations if the guiding policy is inflicted with a high level of ambiguity. The outcome of both types of implementation can have severe consequences. Symbolic implementation entails a lack of action, which can have severe consequences for the environment and the economies and societies that rely on it. Experimental implementation can have both constructive and less-constructive outcomes, which, again, can have negative consequences. In this dissertation, indications of both symbolic and experimental implementation were found.

The lack of collective pressure assessments results in an absence of ecosystem-based approaches in MSP practices in the EU, while, officially, national plans represent the implementation of the MSPD in which it is required to take an ecosystem-based approach. The actual outcome of this implementation is challenging to measure and to evaluate, and, thus, it is not possible to say for sure whether some MSP practices in the EU are symbolic implementation of the Directive, as this would require a larger investigation. Future research could therefore focus on assessing whether there are further indications of symbolic implementation, besides the absence of assessments of collective pressure.

The research of this dissertation found several examples of experimental implementation. The assessment of efficient EBA practices found that successful

practices are highly innovative and that they differ substantially from other practices. In this case, the policy ambiguity pertaining to MSP and EBA has led to constructive outcomes and developments in planning practice. However, it is still not certain whether other forms of experimental implementation, such as the Danish practice in which the plan is formulated as a digital decree in the form of a map, leads to constructive outcomes. Again, future research could contribute by assessing the outcome of these experimental practices.

Following this, policy ambiguity influences the current MSP practice by leaving the interpretation of important concepts and aspects of MSP policies to the planners. This has led to disagreements among planners as well as researchers on the meaning of central concepts, such as EBA. Furthermore, sustainability concepts in policy designs are not well defined, which, in some cases, keeps planners from generating a meaning of these concepts. The level of ambiguity has influenced the current practice of MSP implementation, for which this dissertation found indications of both symbolic and experimental practices.

So how does MSP facilitate sustainability at sea?

Marine spatial planning is generally considered to facilitate sustainability at sea through an ecosystem-based approach. However, ambiguity pertaining to this concept and its implementation has led to widely different interpretations and practices of MSP. This dissertation has found examples of practices that facilitate sustainability successfully by having efficiently implemented an ecosystem-based approach as well as practices that are not considered ecosystem-based and therefore not likely to facilitate sustainability. While MSP is currently seen as a planning practice capable of managing the marine space and the maritime activities that use the space, the management of land-based impacts are today generally not perceived to be within the role of MSP. If the practice does not develop and become an even more holistic practice, in which MSP engage in the management of land-based activities, in some sea regions, MSP would not be capable of ensuring sustainable seas. While still a highly important step towards sustainability, MSP holds greater potential than what is currently being realised and envisioned. For the seas to achieve a good environmental status, MSP must become a holistic practice, in which all pressures are considered and all activities causing these pressures are managed through the implementation of the plan. In this form, MSP would not only be able to facilitate sustainability but would be able to ensure that seas are in a good environmental state able to supply ecosystem services for humans and economies for a sustainable future.

10. How to ensure sustainability at sea

Based on the research conducted for this dissertation, it is possible to formulate recommendations for how to ensure sustainability at sea through MSP. Through a collation of the findings, a suggested approach for how to ensure sustainability through MSP was developed and is presented in Figure 20. This approach can be used by planners independently of policy designs, however, its integration into policy designs would ensure the most efficient operationalisation and chance of success.

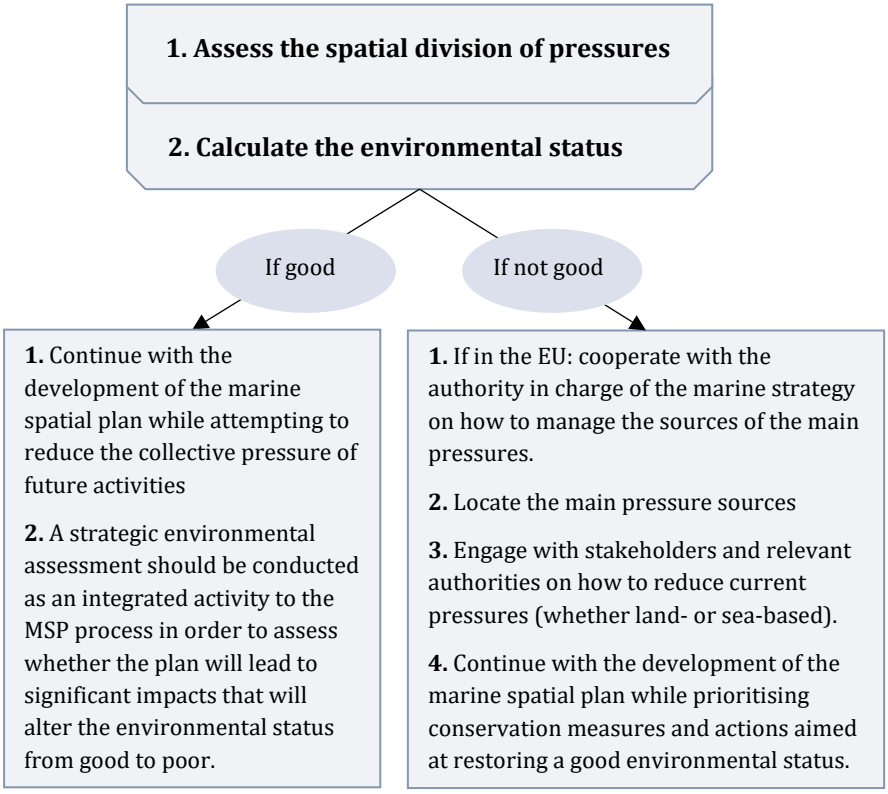


Figure 20 A suggested framework for how to ensure sustainability through MSP. It was generated from the findings of this dissertation.

As a point of departure, all MSP practices should take stock of the environmental status before setting any objectives for the planning process. This stocktaking should involve an assessment of the spatial division of pressures. While this activity is highly data demanding, with an ideal process having a substantial

supply of quantitative as well as qualitative data and use of analytical tools, data is often lacking. As part of this assessment, planners should therefore aim to collect as much data as possible, for example, on ecosystem components and pressures from maritime activities, and make plans for how to improve the assessment in future revisions of the plan. The data analysis is made more efficient by applying the best available technology to the spatial assessment of collective pressure and environmental status.

Second, it is necessary to conduct an assessment of the environmental status before setting any objectives for the MSP process. Depending on whether the environmental status is good or bad, MSP can then go in different directions. If good, the MSP process can proceed with the integral steps of the planning process as presented in Figure 1 (p. 22), which include the prevention and management of user-user and user-environment conflicts as well as the production of a strategic environmental assessment. If the environmental status is not categorised as good, attempts should be made to ensure a good environmental status before any further activities are planned. If the MSP authority is an EU member state, this activity would be more efficient if coordinated with the authority, responsible for the marine strategy and other authorities such as the one in charge of the implementation of the Water Framework Directive (WFD, Directive 2000/60/EC). Depending on how the spatial extent of the marine spatial plan is set, the implementation of the two Directives, MSPD and WFD, are likely to overlap spatially, as the WFD covers inland waters out to 1 nm from the coastline and 12 nm for chemical pollution. The two activities, together with the implementation of the MSFD, have interconnected objectives, as the streams and rivers in-land are connected to the sea. The three frameworks could therefore achieve shared objectives of ensuring a good environmental/ecological status by addressing pressures collectively. A successful cooperation of the three activities could necessitate support from a higher governmental level, as the three activities, in some cases, are managed through separate and significantly different institutional set-ups with different implementation challenges.

No matter the approach, the main pressure sources should be located, and negotiations with stakeholders and relevant authorities should be initiated with the purpose of reducing the collective pressure, whether the sources are from maritime or land-based activities. Following this, the MSP process should prioritise conservation measures as well as activities aimed at restoring a good environmental status.

Throughout the process suggested in Figure 20, it is important that actors in the MSP process, whether politicians in the policy formulation processes, stakeholders or planners, should explicitly discuss what sustainability means in

the context of MSP and formulate clear definitions and guidelines on how to plan for a sustainable future.

11. Prospects for the future

Despite the alarming state of many marine habitats and species, the use of sea space and marine resources continues to increase. In a world in which a growing human population leads to increasing demands for food and energy, the need for space continues to grow. It is therefore reasonable to expect a continuous expansion and development of maritime activities, at least until the growth in global population and affluence comes to a halt or technology sweeps in and saves the day.

The MSPD aims to achieve both a good environmental status and a sustainable development of maritime economies. However, the policy does not clarify the following question: What if it is not possible to have both? What if we have crossed the threshold at which ecosystems can function sustainably? If a good environmental status and economic development are incompatible, which objective is more important, more pressing? One argument could be that one of the largest existing threats to ecosystems, as well as human societies and economies, is climate change. An effective mitigation measure for climate change has proven to be the production of clean energy at sea. While this does involve some impacts on the environment, the environment also benefits from an offshore wind farm, and potential impacts can therefore be outweighed. Another argument could be that it is a basic need for humans to have sufficient sustenance, and while terrestrial areas are already largely exploited, we need to use the oceans for the provision of food, through fishing and aquaculture, which have detrimental impacts on marine environments. Such arguments have fuelled the current level of activity at sea, with the consequent impact on the state of many ecosystems. It is clear that the management of maritime economies and marine areas cannot be viewed in isolation. Marine ecosystems are part of a global, interconnected ecosystem, and maritime economies are, likewise, part of global, intertwined societies.

While the original use of the concept of sustainable development was in relation to support for developing countries (see p. 28), it has now transformed into a common notion used in highly developed countries as well and for purposes that do not relate to the eradication of poverty. As the increase in the human population is decelerating, it will soon become necessary to consider at what cost should we continue to aim for economic development. Advocates of a strong sustainability perspective would suggest measures be taken that prevent

any degradation of natural capital. This could necessitate reducing the effects of a growing population and affluence. One way to solve the current ecological crisis could therefore be to reduce resource use and the carbon footprint of the average world citizen. While many are working hard to achieve this, for example, by increasing the production of renewable energy, one way to effectively ensure such a reduction is to change the current way of living. In itself, the conversion to plant-based diets would substantially reduce global emissions of greenhouse gasses as well as the area taken up by agricultural land. A reduction of the area and intensity of agricultural activities would lead to a lower discharge of nutrients and chemicals to the oceans, which are now placing considerable pressure on marine as well as land-based ecosystems. While the current sustainability discourse is highly focused on development, it could also be argued that a change of focus from sustainable development to a focus on sustainability would facilitate a world in which human activities can sustain a good standard of living without causing ecological degradation.

As for MSP, the practice aims at reaching sustainability objectives pertaining to both maritime economies and marine environments. However, when it is impossible to achieve them all, which should be prioritised over the other? Advocates for strong sustainability would argue that natural capital should not be exchanged for other capital, as it holds value beyond our knowledge and ecological functions that may not return once depleted. Thus, MSP should prioritise sustainability objectives pertaining to the environment over blue growth objectives. Existing MSP policy designs fail to set an order of priorities and, therefore, leave it to the individual planning unit and the actors involved in the planning process to decide which objectives to prioritise. As indicated by research conducted for this dissertation, a lack of political will could explain the ambiguity pertaining to the prioritisation of sustainability objectives. In order to ensure that human economies and societies can continue to rely on the oceans for ecosystem services, future policy designs for MSP need to clearly specify how objectives are to be prioritised, with a good environmental status being at the top of the list. This would ensure MSP practices that are based on ecosystem thresholds aimed at ensuring an environment that is in good condition, which is capable of delivering long-term ecosystem services that would not only sustain marine environments but also support maritime economies and provide humans with opportunities to go explore this wonderful and alien environment.

REFERENCES

Alexander, K. A., Janssen, R., Arciniegas, G. *et al.* (2012) 'Interactive Marine Spatial Planning: Siting Tidal Energy Arrays around the Mull of Kintyre', *PLoS ONE*, 7(1). doi: 10.1371/journal.pone.0030031.

Allsopp, M., Page, R., Johnston, P. *et al.* (2009) *State of the world's oceans*. Springer. doi: 10.1007/978-1-4020-9116-2.

Archer, M., Bhaskar, R., Collier, A. *et al.* (1998) *Critical realism: Essential readings*. New York: Routledge. doi: 10.4324/9781315008592.

Azzellino, A., Ferrante, V., Kofoed, J. P. *et al.* (2013) 'Optimal siting of offshore wind-power combined with wave energy through a marine spatial planning approach', *International Journal of Marine Energy*. Elsevier, 3–4, pp. e11–e25. doi: 10.1016/j.ijome.2013.11.008.

Bellis, M. (2019) *History of Scuba Diving, Jacques Cousteau & Other Inventors*. Available at: https://www.thoughtco.com/history-of-scuba-diving-1991497 (Accessed: 6 October 2020).

Baier, V. E., March, J. G. and Saetren, H. (1986) 'Implementation and Ambiguity', *Scandinavian Journal of Management Studies*, (May), pp. 197–212.

Bennett, M. and Christie, S. (2010) 'Lidar observations of ship plumes in the English Channel', *Conference paper*, May, p. 6.

Berridge, G. R. and James, A. (2003) *A dictionary of diplomacy*. 2nd edn. Basingstoke: Palgrave Macmillan.

Bhaskar, R. (2008) *A realist theory of science*. New York: Taylor and Francis. doi: 10.4324/9780203090732.

Borja, A., Elliott, M., Andersen, J. H. *et al.* (2015) *Report on Potential Definition of Good Environmental Status, Deliverable 6.2*.

Borja, Á., Elliott, M., Carstensen, J. *et al.* (2010) 'Marine management - Towards an integrated implementation of the European marine strategy framework and the water framework directives', *Marine Pollution Bulletin*, 60(12), pp. 2175–2186. doi: 10.1016/j.marpolbul.2010.09.026.

Brown, B. J., Hanson, M. E., Liverman, D. M. *et al.* (1987) 'Global Sustainability: Toward Definition', *Environmental Management*, 11(6), pp. 713–719.

Brundtland, G. (1987) *Report of the World Commission on Environment and Development: Our Common Future*, *United Nations General Assembly document A/42/427.* doi: 10.1080/07488008808408783.

Bryman, A. (2016) *Social research methods*. 5th edn, Oxford, New York: Oxford Univeristy Press.

Campbell, H. and Marshall, R. (2002) 'Values and Professional Identities', in Allmendinger, P. and Tewdwr-Jones, M. (eds) *Planning Futures, New Directions for Planning Theory*. London and New York: Routledge, pp. 93–110. doi: 10.1017/CBO9781107415324.004.

Campbell, M. S., Stehfest, K. M., Votier, S. C. *et al.* (2014) 'Mapping fisheries for marine spatial planning: Gear-specific vessel monitoring system (VMS), marine conservation and offshore renewable energy', *Marine Policy*. Pergamon, 45, pp. 293–300. doi: 10.1016/j.marpol.2013.09.015.

CBD (2019) *Article 1. Objectives*, *Convention Text*. Available at: https://www.cbd.int/convention/articles/default.shtml?a=cbd-01 (Accessed: 31 January 2019).

Collie, J. S., Vic Adamowicz, W. L., Beck, M. W. *et al.* (2013) 'Marine spatial planning in practice', *Estuarine, Coastal and Shelf Science*. Elsevier Ltd, 117, pp. 1–11. doi: 10.1016/j.ecss.2012.11.010.

Crowder, L. and Norse, E. (2008) 'Essential ecological insights for marine ecosystem-based management and marine spatial planning', *Marine Policy*, 32(5), pp. 772–778. doi: 10.1016/j.marpol.2008.03.012.

Cuyvers, L., Berry, W., Gjerde, K. *et al.* (2018) *Deep seabed mining: A rising environmental challenge*. Gland: Switzerland. Available at: http://twitter.com/IUCN/ (Accessed: 28 January 2019).

Dauchy, S. et al. (2016) The Formation and Transmission of Western Legal Culture. Springer International. doi: 10.1007/978-3-319-45567-9.

Depellegrin, D., Menegon, S., Farella, G. *et al.* (2017) 'Multi-objective spatial tools to inform maritime spatial planning in the Adriatic Sea', *Science of the Total Environment*. Elsevier B.V., 609, pp. 1627–1639. doi: 10.1016/j.scitotenv.2017.07.264.

Dewulf, A., Craps, M., Bouwen, R. *et al.* (2005) 'Integrated management of natural resources: Dealing with ambiguous issues, multiple actors and diverging frames', *Water Science and Technology*, 52(6), pp. 115–124. doi: 10.2166/wst.2005.0159.

DNV.GL (2020) *Offshore wind power expands globally*. Available at: https://www.dnvgl.com/expert-story/maritime-impact/Offshore-wind-power-expands-globally.html (Accessed: 19 December 2020).

Douvere, F. (2008) 'The importance of marine spatial planning in advancing ecosystem-based sea use management', *Marine Policy*, 32, pp. 762–771. doi: 10.1016/j.marpol.2008.03.021.

Ehler, C. N. and Douvere, F. (2009) *Marine Spatial Planning: A Step-by-Step Approach towards Ecosystem-based Management*, *Intergovernmental Oceanographic Commission*. Paris.

Elsevier B.V. (2018) *Scopus*. Available at: https://www.scopus.com/search/form.uri?display=basic.

European Commission (1997) 'The EU compendium of spatial planning systems and policies', *European Planning Studies*, p. 192. doi: 10.1080/09654319508720313.

European Commission (2012) *Progress of the EU's Integrated Maritime Policy, Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2012) 491 final*. Belgium. doi: 10.2771/44682.

European Commission (2019) Integrated maritime policy, Maritime Affairs. Available at: https://ec.europa.eu/maritimeaffairs/policy_en (Accessed: 4 February 2019).

European Commission (2021) *About the MSFD*. Available at: https://mcc.jrc.ec.europa.eu/main/dev.py?N=12&O=16&titre_chap=About MSFD (Accessed: 20 January 2021).

European Environment Agency (2019) *Marine messages II, Navigating the course towards clean, healthy and productive seas through implementation of an ecosystem-based approach*. doi: 10.2800/71245.

European MSP Platform (a) (2020) *European MSP Platform*. Available at: http://msp-platform.eu/ (Accessed: 11 January 2021).

European MSP platform (b) (2020) *Maritime Spatial Planning, Country Information, Sweden*. Available at: https://www.msp-platform.eu/sites/default/files/download/sweden_december_2020.pdf (Accessed: 5 October 2020).

FAO (2016) *The State of World Fisheries and Aquaculture (SOFIA) | FAO | Food*

and Agriculture Organization of the United Nations. Rome. doi: 92-5-105177-1.

FAO (2020) *The State of World Fisheries and Aquaculture 2020*, *The State of World Fisheries and Aquaculture 2020*. FAO. doi: 10.4060/ca9229en.

Felici, A. (2012) '"shall" ambiguities in EU legislative texts', *Comparative Legilinguistics*, (10), pp. 51–66.

Finley, C. (2011) *All the fish in the sea: maximum sustainable yield and the failure of fisheries management*. Chicago and London: The University of Chicago Press.

Flannery, W., Ellis, G., Nursey-Bray, M. *et al.* (2016) 'Exploring the winners and losers of marine environmental governance/Marine spatial planning: Cui bono?/"More than fishy business": epistemology, integration and conflict in marine spatial planning/Marine spatial planning: power and scaping/Surely not all', *Planning Theory and Practice*, 17(1), pp. 121–151. doi: 10.1080/14649357.2015.1131482.

Flannery, W., Healy, N. and Luna, M. (2018) 'Exclusion and non-participation in Marine Spatial Planning', *Marine Policy*. Elsevier Ltd, 88(May 2017), pp. 32–40. doi: 10.1016/j.marpol.2017.11.001.

Floor, J. R., van Koppen, C. S. A. and van Tatenhove, J. P. M. (2019) 'Knowledge uncertainties in environmental conflicts: how the mussel fishery controversy in the Dutch Wadden Sea became depoliticised', *Environmental Politics*. Routledge, 28(7), pp. 1236–1258. doi: 10.1080/09644016.2018.1546561.

Fock, H. O. (2008) 'Fisheries in the context of marine spatial planning: Defining principal areas for fisheries in the German EEZ', *Marine Policy*. Pergamon, 32(4), pp. 728–739. doi: 10.1016/j.marpol.2007.12.010.

Foley, M. M., Halpern, B. S., Micheli, F. *et al.* (2010) 'Guiding ecological principles for marine spatial planning', *Marine Policy*. Elsevier, 34, pp. 955–966. doi: 10.1016/j.marpol.2010.02.001.

Garcia Landa, J. A. (2015) 'Theories of Interpretation: Classical to Romantic Hermeneutics', SSRN Electronic Journal, (October). doi: 10.2139/ssrn.2553692.

Gazzola, P. and Onyango, V. (2018) 'Shared values for the marine environment–developing a culture of practice for marine spatial planning', *Journal of Environmental Policy and Planning*, 20(4), pp. 468–481. doi:

10.1080/1523908X.2018.1438253.

Gee, K. and Zaucha, J. (2019) *Maritime spatial planning: past, present, future*. Palgrave, Macmillan. doi: 10.1007/978-3-319-98696-8.

Giddings, B., Hopwood, B. and O'Brien, G. (2002) 'Environment, economy and society: Fitting them together into sustainable development', *Sustainable Development*. John Wiley & Sons, Ltd, 10(4), pp. 187–196. doi: 10.1002/sd.199.

Gilbert, A. J. et al. (2015) 'Marine spatial planning and Good Environmental status: A perspective on spatial and temporal dimensions', Ecology and Society, 20(1). doi: 10.5751/ES-06979-200164.

Gilliland, P. M. and Laffoley, D. (2008) 'Key elements and steps in the process of developing ecosystem-based marine spatial planning', 32, pp. 787–796. doi: 10.1016/j.marpol.2008.03.022.

Gimpel, A., Stelzenmüller, V., Grote, B. *et al.* (2015) 'A GIS modelling framework to evaluate marine spatial planning scenarios: Co-location of offshore wind farms and aquaculture in the German EEZ', *Marine Policy*. Elsevier Ltd, 55, pp. 102–115. doi: 10.1016/j.marpol.2015.01.012.

Gooch, G. and Williams, M. (2007) A Dictionary of Law Enforcement. Oxford University Press. doi: 10.1093/acref/9780192807021.001.0001.

GRI, UN Global Compact and WBCSD (2015) SDG Compass – A Guide for Business Action to Advance the Sustainable Development Goals. Available at: https://sdgcompass.org/ (Accessed: 26 October 2020).

Guðmundsson, G. J. (2006) 'The cod and the cold war', *Scandinavian Journal of History*, 31(2), pp. 97–118. doi: 10.1080/03468750600604184.

Hammar, L., Molander, S., Pålsson, J. *et al.* (2020) 'Cumulative impact assessment for ecosystem-based marine spatial planning', *Science of the Total Environment*, 734, p. 139024. doi: 10.1016/j.scitotenv.2020.139024.

Hattendorf(a), J. B. (2007) 'Law', in *The Oxford encyclopedia of maritime history*. Oxford University Press.

Hattendorf(b), J. B. (2007) 'Fishing', in *The Oxford encyclopedia of maritime history*. Oxford University Press.

Hattendorf(c), J. B. (2007) 'Law of the Sea', in *The Oxford Encyclopedia of Maritime History*. Oxford University Press. doi:

10.1093/acref/9780195130751.001.0001.

Hegland, T. J. (2012) *Fishing for Change in EU Governance: Excursions into the evolution of the Common Fisheries Policy*. Aalborg University.

History (2018) *Bermuda Triangle*. Available at: https://www.history.com/topics/folklore/bermuda-triangle (Accessed: 6 October 2020).

Hjørland, B. (2009) 'Concept Theory', *Journal of the American Society for Information Science & Technology*, 60(8), pp. 1519–1536. doi: 10.1002/asi.

Hjørland, B. (2010) 'Concepts, paradigms and knowledge organization', *Paradigms and conceptual systems in knowledge organization*, 12, pp. 38–42.

Hogenboom, M. (2014) *Are massive squid really the sea monsters of legend?, BBC Earth*. Available at: http://www.bbc.com/earth/story/20141212-quest-for-the-real-life-kraken (Accessed: 6 October 2020).

Hogge, K. (2017) *Ocean Horror Story: Urban Legends of the Sea - Ocean Conservancy*. Available at: https://oceanconservancy.org/blog/2017/10/31/ocean-horror-story-urban-legends-sea/ (Accessed: 6 October 2020).

IPCC (2014) *Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, *Kristin Seyboth (USA)*. Geneva, Switzerland: Gian-Kasper Plattner. Available at: http://www.ipcc.ch. (Accessed: 19 December 2020).

IPCC (2019) *Special Report on the Ocean and Cryosphere in a Changing Climate*. Available at: https://www.ipcc.ch/srocc/ (Accessed: 20 October 2020).

Jägerbrand, A. K., Brutemark, A., Barthel Svedén, J. *et al.* (2019) 'A review on the environmental impacts of shipping on aquatic and nearshore ecosystems', *Science of the Total Environment*. Elsevier B.V., 695, p. 133637. doi: 10.1016/j.scitotenv.2019.133637.

Jarvis, R. M., Breen, B. B., Krägeloh, C. U. *et al.* (2015) 'Citizen science and the power of public participation in marine spatial planning', *Marine Policy*. Elsevier Ltd, 57, pp. 21–26. doi: 10.1016/j.marpol.2015.03.011.

Jegen, M. and Mérand, F. (2014) 'Constructive Ambiguity: Comparing the EU's Energy and Defence Policies', *West European Politics*. Routledge, 37(1), pp. 182–203. doi: 10.1080/01402382.2013.818325.

Jönsson, C. (2016) 'Diplomacy, Communication and Signaling', in Constantinou, C. M., Kerr, P., and Sharp, P. (eds) *The SAGE Handbook of Diplomacy*. SAGE Publications, pp. 79–91. doi: 10.4135/9781473957930.

Kidd, S., Calado, H., Gee, K. *et al.* (2020) 'Marine Spatial Planning and sustainability: Examining the roles of integration - Scale, policies, stakeholders and knowledge', *Ocean and Coastal Management*. Elsevier Ltd, 191(December 2019), p. 105182. doi: 10.1016/j.ocecoaman.2020.105182.

Kidd, S. and Shaw, D. (2013) 'Reconceptualising territoriality and spatial planning: insights from the sea', *Planning Theory and Practice*, 14(2), pp. 180–197. doi: 10.1080/14649357.2013.784348.

Kierkegaard, S. (1983) *The concept of irony: With constant reference to Socrates*. Octagon Books.

Kirkfeldt, T. S. (2019) 'An ocean of concepts: Why choosing between ecosystem-based management, ecosystem-based approach and ecosystem approach makes a difference', *Marine Policy*, 106, p. 103541. doi: 10.1016/j.marpol.2019.103541.

Kirkfeldt, T. S., van Tatenhove, J., Nedergaard, H. *et al.* (2020) 'An ocean of ambiguity in Northern European marine spatial planning policy designs', *Marine Policy*. Elsevier Ltd, 119(April), p. 104063. doi: 10.1016/j.marpol.2020.104063.

Kirkfeldt, T. S. and Andersen, J. H. (2020) 'Assessment of collective pressure in marine spatial planning: The current approach of EU Member States', *Ocean and Coastal Management*. Elsevier Ltd, p. 105448. doi: 10.1016/j.ocecoaman.2020.105448.

Kirkfeldt, T. S., Tatenhove, J. van and Calado, H. (submitted) 'Innovative diversity: the way forward on Ecosystem-based Marine Spatial Planning', submitted to *Coastal Management* on January 14 2021.

Kirkfeldt, T. and Santos, C. F. (under review) 'A review of sustainability concepts in marine spatial planning and the potential to supporting the UN SDG 14', submitted to *Marine Policy* on November 4 2020, *went into review on* Nov 24 2020.

Klein, C. J., Brown, C. J., Halpern, B. S. *et al.* (2015) 'Shortfalls in the global protected area network at representing marine biodiversity', *Scientific Reports*. Nature Publishing Group, 5(1), p. 17539. doi: 10.1038/srep17539.

Knieling, J. and Othengrafen, F. (2015) 'Planning Culture - A Concept to Explain

the Evolution of Planning Policies and Processes in Europe?', *European Planning Studies*, 23(11), pp. 2133–2147. doi: 10.1080/09654313.2015.1018404.

Korpinen, S., Klančnik, K., Peterlin, M. *et al.* (2019) *Multiple pressures and their combined effects in Europe's seas*.

Kurlansky, M. (1999) Cod: a biography of the fish that changed the world. Vintage.

Laperche, B., Levratto, N. and Uzunidis, D. (2012) *Crisis, Innovation and Sustainable Development: The Ecological Opportunity*. Edward Elgar Publishing Limitid.

Leaffer, R. (1584) 'Mare clausum (The Closure of the Sea or The Ownership of the Sea) 1635 John Selden (1584-1654)', in Dauchy, S. et al. (eds) *The Formation and Transmission of Western Legal Culture. 150 Books that Made the Law in the Age of Printing*. Springer Verlag 2016, pp. 190–4. Available at: https://core.ac.uk/download/pdf/80808023.pdf (Accessed: 29 January 2019).

Lonsdale, J. A., Nicholson, R., Judd, A. *et al.* (2020) 'A novel approach for cumulative impacts assessment for marine spatial planning', *Environmental Science and Policy*. Elsevier, 106(January), pp. 125–135. doi: 10.1016/j.envsci.2020.01.011.

Martí, C.-P. (2018) *The Common Fisheries Policy: Origins and Development, Fact Sheets on the European Union*, *European Paliament*. Available at: http://www.europarl.europa.eu/factsheets/en/sheet/114/the-common-fisheries-policy-origins-and-development (Accessed: 31 January 2019).

Matland, R. E. (1995) 'Synthesizing the Implementation Literature: The Ambiguity-Conflict Model of Policy Implementation', *Journal of Public Administration Research and Theory*. Oxford University Press (OUP), 2(May), pp. 145–174. doi: 10.1093/oxfordjournals.jpart.a037242.

Matthews, J. A. (2014) 'Mariculture', in *Encyclopedia of Environmental Change*. California: SAGE Publications, Ltd. doi: 10.4135/9781446247501.n2376.

May, P. J. (2012) 'Policy Design and Implementation', in Peters, G. and Pierre, J. (eds) The SAGE Handbook of Public Administration. London: SAGE Publications Ltd, pp. 279–291. doi: http://dx.doi.org/10.4135/9781446200506.n18 Print.

Miller, M. B. (2012) *Europe and the maritime world: A twentieth-century history*,

Europe and the Maritime World: A Twentieth-Century History. Cambridge University Press. doi: 10.1017/CBO9781139170048.

Mingers, J., Mutch, A. and Willcocks, L. (2013) 'Critical Realism in Information Systems Research', *MIS Quarterly*, 37(3), pp. 795–802.

Moore, F. (2011) 'Toppling the Tripod: Sustainable Development, Constructive Ambiguity and the Environmental Challenge', *Consilience: The Journal of Sustainable Development*, 5(5), pp. 141–150. doi: 10.7916/D8668CW6.

Morf, A., Moodie, J., Gee, K. *et al.* (2019) 'Towards sustainability of marine governance: Challenges and enablers for stakeholder integration in transboundary marine spatial planning in the Baltic Sea', *Ocean and Coastal Management*. Elsevier, 177(September 2018), pp. 200–212. doi: 10.1016/j.ocecoaman.2019.04.009.

National Research Council (2001) 'Historical Background and Evaluation of Marine Protected Areas in the United States', in *Marine Protected Areas: Tools for Sustaining Ocean Ecosystem*. Washington, D.C.: National Academies Press, pp. 145–173. doi: 10.17226/9994.

Natkiel, R. and Preston, A. (1986) *Atlas of maritime history*. Facts on File, Inc. Available at: https://books.google.dk/books/about/Atlas_of_Maritime_History.html?id=yooRAAAAYAAJ&redir_esc=y (Accessed: 29 January 2019).

Naylor, R. and Burke, M. (2005) 'Aquaculture and Ocean Resources: Raising Tigers of the Sea', *Annual Review of Environment and Resources*. Annual Reviews, 30(1), pp. 185–218. doi: 10.1146/annurev.energy.30.081804.121034.

NOAA (2019) *How Oil Harms Animals and Plants in Marine Environments* . Available at: https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/how-oil-harms-animals-and-plants-marine-environments.html (Accessed: 19 December 2020).

NOAA (2020) *How much oxygen comes from the ocean?* Available at: https://oceanservice.noaa.gov/facts/ocean-oxygen.html (Accessed: 19 December 2020).

Ntona, M. and Morgera, E. (2018) 'Connecting SDG 14 with the other Sustainable Development Goals through marine spatial planning', *Marine Policy*. Elsevier Ltd, 93(January 2017), pp. 214–222. doi: 10.1016/j.marpol.2017.06.020.

Nyhart, L. K. (1998) 'Civic and Economic Zoology in Nineteenth-Century Germany: The "Living Communities" of Karl Mobius', *History of Science Society*, 89(4), pp. 605–630. Available at: https://about.jstor.org/terms (Accessed: 31 January 2019).

Ogden, C. K. and Richards, I. A. (1989) The meaning of meaning: a study of the influence of language upon thought and of the science of symbolism. Harcourt Brace Jovanovich.

Othengrafen, F. (2010) 'Spatial planning as expression of culturised planning practices: The examples of Helsinki, Finland and Athens, Greece', *Town Planning Review*, 81(1), pp. 83–110. doi: 10.3828/tpr.2009.25.

Othengrafen, F. and Reimer, M. (2013) 'The embeddedness of planning in cultural contexts: Theoretical foundations for the analysis of dynamic planning cultures', *Environment and Planning A*, 45(6), pp. 1269–1284. doi: 10.1068/a45131.

Ott, K., Muraca, B. and Baatz, C. (2011) 'Strong Sustainability as a Frame for Sustainability Communication', in Godemann, J. and Michelsen, G. (eds) *Sustainability Communication, Interdisciplinary Perspectives and Theoretical Foundations*. Springer, p. 208. doi: 10.1007/978-94-007-1697-1.

Outeiro, L., Häussermann, V., Viddi, F. *et al.* (2015) 'Using ecosystem services mapping for marine spatial planning in southern Chile under scenario assessment', *Ecosystem Services*. Elsevier, 16, pp. 341–353. doi: 10.1016/j.ecoser.2015.03.004.

Pınarbaşı, K., Galparsoro, I., Borja, A. *et al.* (2017) 'Decision support tools in marine spatial planning: Present applications, gaps and future perspectives', *Marine Policy*, 83, pp. 83–91. doi: 10.1016/j.marpol.2017.05.031.

Purvis, B., Mao, Y. and Robinson, D. (2019) 'Three pillars of sustainability: in search of conceptual origins', *Sustainability Science*. Springer Japan, 14(3), pp. 681–695. doi: 10.1007/s11625-018-0627-5.

Rafferty, J. P. (2020) *9 of the Biggest Oil Spills in History* . Available at: https://www.britannica.com/list/9-of-the-biggest-oil-spills-in-history (Accessed: 19 December 2020).

Rey, G. (1994) 'Concepts', in Guttenplan, S. (ed.) *A Companion to the Philosophy of Mind*. Oxford: Blackwell Publishing Ltd, p. 642. doi: 10.1002/9781405164597.

Rilov, G., Fraschetti, S., Gissi, E. *et al.* (2020) 'A fast-moving target: achieving

marine conservation goals under shifting climate and policies', *Ecological Applications*, 30(1), pp. 1–14. doi: 10.1002/eap.2009.

Sander, G. (2018) 'Against all odds? Implementing a policy for ecosystem-based management of the Barents Sea', Ocean and Coastal Management. Elsevier, 157(January), pp. 111–123. doi: 10.1016/j.ocecoaman.2018.01.020.

Santos, C. F., Domingos, T., Ferreira, M. A. *et al.* (2014) 'How sustainable is sustainable marine spatial planning? Part I-Linking the concepts', *Marine Policy*. Elsevier, 49, pp. 59–65. doi: 10.1016/j.marpol.2014.04.004.

Sanyal, B. (2012) *Comparative planning cultures*. Taylor and Francis. doi: 10.4324/9780203826508.

SPC (2013) *Deep Sea Minerals and the green economy*. 2nd edn. Edited by E. Baker and Y. Beaudoin. Secretariat of the Pacific Community. Available at: https://gridarendal-website-live.s3.amazonaws.com/production/documents/:s_document/347/original/DSM_vol2_screen.pdf?1504174905 (Accessed: 29 January 2019).

Stead, D., de Vries, J. and Tasan-Kok, T. (2015) 'Planning Cultures and Histories: Influences on the Evolution of Planning Systems and Spatial Development Patterns', *European Planning Studies*, 23(11), pp. 2127–2132. doi: 10.1080/09654313.2015.1016402.

Stelzenmüller, V., Lee, J., South, A. *et al.* (2013) 'Practical tools to support marine spatial planning: A review and some prototype tools', *Marine Policy*, 38, pp. 214–227. doi: 10.1016/j.marpol.2012.05.038.

Stone, D. (2012) *Policy Paradox: The Art of Political Decision Making*. 3rd edn. W. W. Norton & Company.

Strickland-Munro, J., Kobryn, H., Brown, G. *et al.* (2016) 'Marine spatial planning for the future: Using Public Participation GIS (PPGIS) to inform the human dimension for large marine parks', *Marine Policy*. Elsevier, 73, pp. 15–26. doi: 10.1016/j.marpol.2016.07.011.

Symes, D. (1997) 'The European Community's common fisheries policy', *Ocean & Coastal Management*. Elsevier, 35(2–3), pp. 137–155. doi: 10.1016/S0964-5691(97)00030-6.

Szostak, R. (2010) 'Letter to the Editor, Comment on Hjørland's Concept Theory', *Journal of the American Society for Information Science & Technology*, 61(5), pp. 1078–1079. doi: 10.1002/asi.

The White House (2010) *Executive Order 13547. Stewardship of the Ocean, Our Coasts, and the Great Lakes | whitehouse.gov*. Available at: https://obamawhitehouse.archives.gov/the-press-office/executive-order-stewardship-ocean-our-coasts-and-great-lakes (Accessed: 31 August 2020).

Thornton, H. (2004) 'Hugo Grotius and the Freedom of the Seas!', *International Journal of Maritime History*, 2(16), pp. 17–38. Available at: https://journals.sagepub.com/doi/pdf/10.1177/084387140401600203 (Accessed: 29 January 2019).

Toonen, H. M. (2013) *Sea@shore: Informational governance in marine spatial conflicts at the North Sea*. Wageningen University.

Toulmin, S. (2003) 'The evolution of scientific ideas', in Gerard, D. and Piet, S. (eds) *Philosophies of Social Science: The Classic and Contemporary Readings.* Maidenhead: Open University Press.

Trouillet, B. (2020) 'Reinventing marine spatial planning: a critical review of initiatives worldwide', *Journal of Environmental Policy & Planning*. Taylor & Francis, 0(0), pp. 1–19. doi: 10.1080/1523908X.2020.1751605.

Turnhout, E., Hisschemöller, M. and Eijsackers, H. (2007) 'Ecological indicators: Between the two fires of science and policy', *Ecological Indicators*, 7(2), pp. 215–228. doi: 10.1016/j.ecolind.2005.12.003.

UNESCO (2020) *Status of MSP*. Available at: http://msp.ioc-unesco.org/world-applications/status_of_msp/.

United Nations (1982) *United Nations Convention on the Law of the Sea*. Geneva. Available at: http://www.un.org/Depts/los/convention_agreements/texts/unclos/unclos_e.pdf (Accessed: 30 January 2019).

United Nations (2018) *Goal 14*, *Sustainable Development Knowledge Platform*. Available at: https://sustainabledevelopment.un.org/sdg14 (Accessed: 31 January 2019).

United Nations (2019) *United Nations Treaty Collection, the Law of the Sea*. Available at: https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXI-3&chapter=21&clang=_en (Accessed: 30 January 2019).

Walker, R., Bokuniewicz, H., Carlin, D. *et al.* (2016) *Effects of extraction of marine sediments on the marin environment 2005-2011*. Available at: www.ices.dk (Accessed: 28 January 2019).

WindEurope (2019) *History of Europe's wind industry · WindEurope*. Available at: https://windeurope.org/about-wind/history/ (Accessed: 30 January 2019).

Winter, S. and Nielsen, V. L. (2008) *Implementering af politik*. 1st edn. Academica.

Winter, S. (2012) 'The SAGE Handbook of Public Administration', in Peters, G. and Pierre, J. (eds) The SAGE Handbook of Public Administration. London: SAGE Publications Ltd, pp. 255–264. doi: 10.4135/9781446200506.

World Ocean Review (2015) *What is sustainability?*, *Sustainability theories*. Available at: https://worldoceanreview.com/en/wor-4/concepts-for-a-better-world/what-is-sustainability/ (Accessed: 31 January 2019).

PAPERS

The following pages consist of the three published papers as well as pre-prints for the two papers that are not yet published at the time of writing. For the two unpublished papers, supplementary materials are as well included, while for the published papers, supplementary materials can be found either online or as an addendum to the paper.

Paper 1 (P1)
T. S. Kirkfeldt (2019) An ocean of concepts: why choosing between ecosystem-based management, ecosystem-based approach and ecosystem approach makes a difference, *Marine Policy* (106), p. 103541, Elsevier Ltd, doi: 10.1016/j.marpol.2019.103541.

Paper 2 (P2)
T. S. Kirkfeldt, van Tatenhove J.P.M., Nielsen H.N. and Larsen S.V. (2020) An ocean of ambiguity in Northern European marine spatial planning policy designs, *Marine Policy* (119), p.104063, Elsevier Ltd, doi: 10.1016/j.marpol.2020.104063

Paper 3 (P3)
T. S. Kirkfeldt and Andersen J.H. (2020) Assessment of collective pressure in marine spatial planning: The current approach of EU Member States, *Ocean and Coastal Management*, Elsevier Ltd, doi: 10.1016/j.ocecoaman.2020.105448.

Paper 4 (P4)
T. S. Kirkfeldt, van Tatenhove J.P.M. and Calado H. M. G. (submitted) Innovative diversity: the way forward on Ecosystem-based Marine Spatial Planning, submitted to *Coastal Management* on January 14 2021.

Paper 5 (P5)
T. S. Kirkfeldt and Santos C. F. (under review) A review of sustainability concepts in marine spatial planning and the potential to supporting the UN SDG 14, submitted to *Marine Policy* on Nov 4 2020, went into review on Nov 24 2020.

Paper 1

T. S. Kirkfeldt (2019) An ocean of concepts: why choosing between ecosystem-based management, ecosystem-based approach and ecosystem approach makes a difference, *Marine Policy* (106), p. 103541, Elsevier Ltd, doi: 10.1016/j.marpol.2019.103541.

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An ocean of concepts: Why choosing between ecosystem-based management, ecosystem-based approach and ecosystem approach makes a difference

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ABSTRACT

The need for management approaches based on ecosystem perspectives that thoroughly incorporate ecosystem considerations into marine planning has become increasingly urgent. In response, concepts such as ecosystem-based management (EBM), ecosystem-based approach (EBA) and ecosystem approach (EA) are increasingly being applied in marine/maritime spatial planning (MSP). The purpose of this article is to clarify potential differences and similarities between the three concepts and potential consequences of choosing one over the others. From a questionnaire and literature analysis, the findings showed vast disagreements on how the concepts are related, however the main perception is that the concepts overlap. Respondents agreed that a lack of clear definitions and understandings of the three concepts causes confusion and expect negative consequences for planning outcomes. Eleven principles for how the concepts are ideally performed were found, including; *acknowledge interlinkages, see humans as a part of the ecosystem* and *consider cumulative impacts*. While a complete overlap between EBM and EA principles were found, the weighting of each principle was different for each concept. Differences were also found in objectives of the concepts, where definitions of EBM were the only ones to include the objective of *co-existence* and definitions of EBA the only to include objectives of *impact management* and *good environmental status*. As this could have consequences in planning processes and thus in the outcomes, it is crucial that MSP practitioners and stakeholders are aware of different perceptions so that choosing between concepts does not lead to less ambitious or inadequate outcomes.

1. Introduction

Over the last half a century, human pressures on marine ecosystems have significantly increased [1,2]. Known consequences are loss of biodiversity, degradation of habitats and the depletion of resources, which are essential for the well-being of human societies all over the world [3,4]. This development has created a need for management practices that enable sustainable planning of maritime activities and the management of marine ecosystems [5,6]. In order to ensure healthy and productive ecosystems, such practices need to take an approach that respects and base decision-making on the ecological limits and spatial boundaries of ecosystems [7,8].

In response to the need to conceptualise such approaches, several management concepts have been formulated. Some of these concepts derive from a long tradition of terrestrial ecosystem management. The practice of ecosystem management was conceptualized in the beginning of the twentieth century with a focus on nature reserve management and conservation of species on land [9]. Also within terrestrial management, the concept of ecosystem-based management (EBM) was formulated around the 1950s. A couple of decades later, the concept of ecosystem approach (EA) started occurring, although also mostly related to terrestrial ecosystems [10,11]. EA became more popular as a concept after the United Nations Conference on Environment and Development in 1992 in Rio de Janeiro and even more when the Convention on Biological Diversity (CBD) chose to use the concept of EA and produced a guideline for its implementation [12,13]. During the last decades, these concepts have been applied increasingly to the management of marine resources and to marine/maritime spatial planning (MSP), which is a strategic planning process through which the spatial division of activities at sea is allocated [14]. During the same period, additional management concepts or variations of the already existing concepts have been formulated, such as an ecosystem-based approach (EBA) [12]. MSP is widely recognised as an ideal tool for the implementation and operationalisation of EBM, EBA and EA [15].

Management concepts that seek to implement an ecosystem perspective into marine planning (i.e. planning of marine space, resources

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and/or ecosystem components), such as EBM, EBA and EA, have been found difficult to define and are now, as a result, increasingly being applied without clear definitions or strategy for operationalisation of these concepts [6,13,16]. For example, within the two main EU directives in regards to marine management, the Marine Strategy Framework Directive[1] (MSFD) and Maritime Spatial Planning Directive[2] (MSPD), member states are required to take an ecosystem-based approach in their marine strategies and plans "*with the aim of ensuring that the collective pressure of all activities is kept within levels compatible with the achievement of good environmental status*".[2] While the aim for good environmental status involves eleven distinct descriptors [17], definitions on EBA and how this is operationalised are lacking, and responsible agencies will therefore have to create or choose a definition themselves, potentially influencing the prospect of creating sustainable strategies and plans [3]. As a response to the lack of clear definitions, guidance documents for similar or closely related concepts have been formulated. The growing number of guidance documents and interrelated concepts has, according to Sardá et al. (2015), led to confusion and difficulties in the operationalisation of the concepts in planning processes, which in the end is the reason these concepts are rarely effectively operationalised [18]. Consequently, examples of EBM, EBA and EA operationalisation through MSP are few. Operationalisation is often evaluated according to principles of EBM, EBA and EA, such as the need to determine spatial division and spatial extent of the plan on ecosystem boundaries, but findings from MSP case studies have showed that many principles are often not operationalised [4,8,15]. Consistent with this, Long et al. (2015) found, in an assessment of EBM principles, that there is a lack of a common agreement and understanding of EBM principles, and that this has hindered the generation of a broadly recognised framework for implementation. This has in turn left the task of defining EBM and the implementation procedure to the responsible planning unit, who has tended to frame the concept to fit the overall objective of that institution [6]. Previous research in marine planning contexts have shown how different understandings of i.a. the definition of natural phenomena can create conflict and affect outcomes in transboundary collaborations [19] and how the interpretation of management concepts such as the precautionary approach can have consequences for entire industries [20]. Ansong et al. (2017) also stress how a lack of a universal conceptual understanding of these concepts facilitate misunderstandings and hereby also unclear objectives and conflicts in the planning process [5]. In addition, Jay et al. (2016) believe that increased mutual awareness of different perceptions of EA, EBA and EBM will facilitate better outcomes based on clear ecosystem ideals [16]. The findings of these publications indicate the importance of having a clear definition of such concepts when initiating an MSP process, in order to avoid misunderstandings and conflicts that could negatively affect the outcome. The risk of misunderstandings and conflicts could be even higher for cases of MSP, which, due to its transboundary nature, involves interaction of planning units from different states. Differences in legislative frameworks and national planning traditions could lead to different perceptions of e.g. principles and objectives of EBM, EBA and EA. These different perceptions could in turn influence the setting of objectives and thus the outcome of MSP. This further indicates a need for concise and internationally acknowledged definitions of the three concepts. There is thus an agreement in research that there is a lack of universal understandings of concepts of ecosystem perspectives in marine planning. However, authors of this research have so far either focused on one concept, such as EA, or seen no significant difference between several concepts and thus approached them collectively as one concept in their research. For instance, Arkema et al. (2006) assessed EBM, ecosystem management and ecosystem based fisheries management collectively as they were seen as similar concepts in terms of values and principles for how the concepts are properly performed. The authors believe that having only one concept instead of multiple similar concepts could increase the understanding of principles and hereby enhance the level of implementation [21]. The purpose of this article is to uncover common differences as well as the overlap between three concepts used most frequently for the inclusion of ecosystem perspectives (EBM, EBA and EA) in marine planning and, based on this, raise awareness of what the results of choosing one concept over the others could be for outcomes of marine planning processes.

2. Methods and materials

2.1. Literature analysis

A substantial part of the assessment of concepts of ecosystem considerations in marine planning was done through an extensive literature analysis of articles and marine spatial plans. These were collected through two literature searches; one for articles and one for marine spatial plans.

The literature search for articles was performed using Scopus to locate English written articles including the search words "ecosystem", "marine" and "planning" in the abstract, title or keywords, and published in the period of 2009–2019. This resulted in 1300 articles, which were then scrutinised individually for the criteria that they should (1) contain and (2) distinctly define at least one concept for the inclusion of ecosystem perspectives into holistic marine planning i.e. marine planning that focus on multiple sectors/activities. Thus, sectoral concepts such as ecosystem-based fisheries management and ecosystem approach to aquaculture were not included in the final selection of articles. This resulted in 97 articles for further analysis. Marine spatial plans were searched based on the same criteria. For this purpose, the EU MSP Platform[3] and the overview of current marine spatial plans provided by Santos et al. (2019) [22] were used to identify potential plans for further analysis. This process resulted in 17 plans[4] (out of 48) that met the criteria as stated above. The 97 articles and 17 plans were coded using the software Nvivo for their use and definitions of ecosystem-oriented concepts.

2.2. Coding of definitions

In order to focus the assessment on the most popular concepts used in marine planning contexts with the aim of incorporating ecosystem perspectives, the 114 documents were first coded for any concepts that met this description. Definitions of the three most popular concepts (EBM, EBA and EA) were then selected and coded further.

The process of coding is a structured way of analysing texts, by breaking it down into smaller and tangible themes that allow the assessor to see greater themes as well as similarities and differences between texts. Codes are used to locate elements of texts that belong to a certain category/theme, and can be thematic, where codes are assigned beforehand, or data based [23]. The coding process for this research was dynamic and data based, i.e. codes were named during the process based on what was found in the definitions of EBM, EBA and EA. 49 codes were formulated from the first round of coding (including: sustainability, adaptive, co-existence etc., see Appendix A for all codes). Based on these codes, it was clear that definitions included four segments that described the concepts from different angles. The four segments described the concepts in terms of 1) what the concept is, 2) what

[1] DIRECTIVE 2008/56/EC.
[2] DIRECTIVE 2014/89/EU.
[3] https://www.msp-platform.eu/.
[4] From Australia (one from 1999 and one from 2004), Canada (four plans, all from 2015), The Netherlands (one from 2015), New Zealand (one from 2017), United Kingdom (three from 2014, 2017 and 2018, respectively), Germany (one from 2009) and the United States (one from 2010, one from 2011, two from 2015 and one from 2016).

Table 1
The four groups containing 49 codes. The full list of codes can be seen in Appendix A.

Code group	Citations that could follow:	Total no. of citations	Examples of codes
1. Instrumental characterisation	"It is a …"	175	Strategy, tool, framework etc.
2. Objectives	"… with the aim of …"	146	Sustainability, economic benefits, good environmental status etc.
3. Principles	"You should …"	147	Acknowledge interlinkages, balance objectives, apply the precautionary principles etc.
4. Process	"The planning process should include …"	84	Stakeholder involvement, long-term perspectives etc.

the objectives of the concept are, 3) on which principles is it properly operationalised and 4) what this requires of the planning process. The 49 codes were divided in four corresponding groups (as presented in Table 1). All definitions were scrutinised according to the codes, and citations were marked and categorised under the relevant code. In most cases, citations within a code varied in wordings, for instance, the code *Balance objectives* in the *Principles* code group contained the citation "… integrates ecological, social, economic, commercial, health, and security goals …" [24] as well as "… reconciling maritime policy with conservation objectives." [25]. Similarly, the code *Acknowledge Interlinkages* also in the *Principles* group contained the citation "… recognizes the full array of interactions within a marine ecosystem, including humans." [5] and "… consider the links between terrestrial, coastal and marine environments." [26]. A code was only registered once per analysed document, in order to equalise the influence of each document in the results.

Due to the dynamic nature of the coding process, all coded and categorised citations were re-assessed after all documents were coded, in order to ensure that all citations were in the right code group. During this process, some citations were moved to another group, some codes were given another name and some codes changed code group. For this article, only the two code groups of *principles* and *objectives* were further analysed. This focus was chosen because principles and objectives of concepts were seen to be more unique to, and characteristic of, concepts such as EBM, EBA and EA than instrumental characterisation and procedural specifications. This analysis included a comparison of the principles and objectives included in definitions of EBM, EBA and EA with particular focus on overlap and differences between the three concepts.

2.3. Questionnaire

In addition to the analysis of the selected plans and articles, a questionnaire was created with the intention to supplement and expand on the literature analysis by focusing on how MSP practitioners and researchers relate the three most popular concepts to each other and how they define the concepts. Respondents were for instance asked to define each concept as well as any differences and similarities between the three. They were also asked what they expect the result of having three so similar concepts can be prospectively. The questionnaire was distributed through the MSP Research Network,[5] the EU MSP Platform[6] and the MEAM (Marine Ecosystems and Management).[7] This resulted in 41 responses from respondents situated in 20 different countries, of whom 48% identified themselves as planners, 38% as experts and 14% as consultants. These responses lead to additional discussions and dialogue with some of the respondents concerning the three concepts, which brought increased insight. For questionnaire questions and answers, please see Appendix B.

[5] https://www.msprn.net/home.
[6] https://www.msp-platform.eu/.
[7] https://meam.openchannels.org/.

3. Results

3.1. An ocean of concepts

The first coding of the literature was focused on which concepts were used in holistic marine contexts with regard to the incorporation of ecosystem perspectives in planning practices. This showed a list of 20 concepts that all define a way of incorporating ecosystem aspects in marine planning. These included for example large marine ecosystem approach, ecosystem services approach and ecosystem management (for the full list, see Appendix C). Of the 20 concepts, three concepts were used more often than the rest and were collectively found in 111 of the 114 documents. The three concepts; ecosystem-based management, ecosystem approach and ecosystem-based approach were each cited in 97 (EBM), 57 (EA) and 48 (EBA) documents. Out of the 111 documents containing at least one of the three concepts, 62 documents used at least two of the three concepts and 15 documents used all three concepts.

The number of concepts per publication could indicate an overlap between the three concepts or that they are perceived to be similar. It was therefore assessed how the concepts were related in these publications. This showed that the majority (71%) of the 62 documents, with more than one concept, offers no clarification of whether the concepts are considered the same or whether the authors see them as different practices. Another 26 % of the documents with more than one concept explain for at least two of the concepts that they are considered the same, whereas 5 % see at least two of them as being distinct. The lack of conceptual clarification or distinction of the concepts can to some extent be explained through the questionnaire responses. Of the 41 respondents, 31 gave a clear indication of how they relate the three concepts to each other. In line with the literature analysis, 71% of these respondents see the three concepts as being neither identical nor completely distinct from each other. 23% see the concepts as being different and 6% see them as identical, which is an opposite division to the literature analysis (where 5% see the concepts as being different and 26% see them as identical).

The high number of documents that use more than one concept without clarifying the relations between them is in line with the 71% of the respondents who neither see them as identical nor as completely distinct concepts. Although there are MSP practitioners and researchers that see the three concepts as being either identical or distinct concepts, the general perception from both the literature analysis and questionnaire is that the three concepts overlap to some extent. There seems however to be disagreements on the extent of the overlap. Among the 71% of the respondents who see the concepts as somewhere in between being identical and being completely distinct, half state that the concepts are roughly the same. The other half leans towards distinguishing between the concepts, by describing some differences or saying that one of the three concepts is different from the others.

3.2. The overlap and the differences

The coding process showed that definitions of the three concepts found in the 111 documents overlap on some parameters. Five principles were found in both EBM, EBA and EA definitions (see Table 2).

Table 2
Principles found through the coding of definitions from 111 documents using EBM, EBA and/or EA. The principles are listed according to the total number of documents using that principle in either EBM, EBA or EA definitions. 9a and 9b were cited the same number of times.

	Common principles of EBM, EBA and EA	Additional principles of EBM and EA
1	Acknowledge interlinkages	
2	See humans as a part of the ecosystem	
3	Consider cumulative impacts	
4		Consider ecological/environmental factors
5	Consider social/cultural factors	
6		Balance objectives
7	Apply the precautionary principle	
8		Consider ecosystem services
9a		Consider economic factors
9b		Consider global trends
10		Base decisions on societal choice

With decreasing number of citations these are: *acknowledge interlinkages, see humans as part of the ecosystem, consider cumulative impacts, consider social/cultural factors* and *apply the precautionary principle*. In addition, EBM and EA share another six principles, i.e.: *consider ecological/environmental factors, balance objectives, consider ecosystem services, consider economic factors, consider global trends* and *base decisions on societal choices*. The reason for the lower number of principles found for the EBA concept can be due to the number of definitions. Although the concept of EBA was found in 48 documents, the concept was only defined 11 times and by shorter definitions than EBM and EA. The concept of EBA was more often defined by either referring to EBM or EA than by the use of the EBA concept itself, which could be a result of the historical development of the three concepts, EBA being the latest to arrive.

Although the three concepts share principles, the weighting of each principle varies between the concepts. For instance, the most frequently cited principle in EBA definitions were 2 and 3, while for EBM it was 1, and for EA it was 4. This indicates a more systemic and holistic focus in EBM compared to the others, whereas the focus of EA on ecological/environmental factors might be more emphasised than in EBM or EBA practices. The high level of similarity between EBM and EA principles could however be an indication of the high level of interchanging use of the concepts in some documents, i.e. some authors perceive them as identical concepts and might therefore define them by the same principles. When looking at what sources are referred to when defining either EA or EBM, there is however a clear distinction. The three most popular sources for EBM definitions were McLeod et al. (2005) [30] (used by 30% of the coded documents with EBM definitions), McLeod and Leslie (2009) [31] (used by 16%) and Leslie and McLeod (2007) [32] (used by 12%), showing a clear tendency that EBM definitions are often formed on principles defined by the same community of researchers. While the geographical foundation of this community is placed in North America, this could also indicate why the concept of EBM is more popular in North America than in the EU, as indicated in textbox 1. 41% of EA definitions were based on principles formulated by the Convention of Biological Diversity (CBD), with reference to CBD literature such as [13,33].

While the geographical foundation of popular sources of definitions can influence the use of concepts, the time of publication for such documents might as well be evident in the use of the three concepts, as indicated in textbox 2.

When compared with other research of principles within concepts of ecosystem aspects in marine planning, there are resemblances on a range of the principles found in this assessment. The principles found by Long et al. (2015) [6] of *recognise coupled social-ecological systems* and *consider ecosystem connections* both relate to the first and fourth principle in Table 2. Related to principles 3, 7, 9a and 10, Long et al. also found principles of *consider cumulative impacts, apply the precautionary approach, consider economic context* and *decisions reflect societal choice*. In addition, Arkema et al. (2006) [21] found criteria for EBM definitions of *ecosystem goods and services* (corresponding to 8 in Table 2) and *inclusion of humans in ecosystem* (corresponding to 2). The principles of 5, 6 and 9b found in the present analysis were not found as distinct principles in the other two assessments, which could be explained by the differences in analysed concepts and literature. It could however also be an indication that these concepts are being used more and more often in holistic planning processes with the growing practice of MSP. In such practices, it is increasingly imperative to take more holistic approaches, including the consideration of global trends (9b) (such as climate change [27]) and the skill of balancing multiple objectives (6) [28] including considerations of social/cultural factors (5) [29]. Another interesting development is how the concept of cumulative impacts has gone from being non-existing in the 2006 assessment of Arkema et al. to being present, albeit to a low degree, and recognised as an upcoming principle in 2015 by Long et al. and then, for this survey, to being among the top three principles. This could also be a result of an increasing need for holistic assessments in MSP.

The respondents had various perceptions of how the three concepts overlap, and on which parameters they were similar. The large group (71%), who neither sees them as identical nor completely distinct has different and often conflicting perceptions of how and on which parameters the concepts overlap. Three respondents perceive EA as having a stronger focus on ecology than EBA and EBM, both of which are seen to have more focus on sustainable development. In contrast to this, three other respondents see EBM as being more focused on ecological sustainability than EA and EBA. In addition, there are conflicting perceptions in terms of how the three concepts relate within the planning framework. Three respondents see EBM as a management framework based on EA or EBA, while another respondent sees EA as an umbrella term that covers the others. These contradicting perceptions show the general level of divergence in perceptions of the concepts among the respondents.

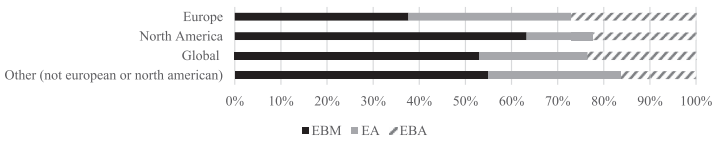
3.3. Influence on planning outcomes

The use of the three concepts in marine planning processes can influence the outcome by being too impalpable, indistinct and difficult to concretise, as it has been stressed by other researchers [6,16,18,21]. To the question of whether the respondent found it confusing that three so closely related concepts exists, 17% of the respondents answered *yes* and 49% answered *to some extent*. In addition, when asked what the result of having three so similar concepts could be, 66% thinks it will have negative consequences in planning processes. 48% expects it to lead to confusion, and some suggested it will also result in misunderstandings, waste of valuable time, uncertainty of what is expected of MSP practitioners, unclear objectives and unclear outcomes. This suggests that there is still a need to increase the clarity on what these concepts entail, which goes against the general movement in research on EBM, EBA, EA and related concepts. Research within this field has gone from focusing on conceptualisation of concepts to the practice of operationalising these concepts in planning processes. Nevertheless, the statements in the questionnaire suggest there is still a need for clearer conceptualisation of EBM, EBA and EA. While a lack of clarity of the definitions and relations between the concepts can influence the outcome as expected by the respondents, concepts can also influence the outcome by having clear and well-defined objectives, as intended. It is therefore important to be aware of the objectives of EBM, EBA and EA, when dedicating a planning process to either one or several of these concepts. Objectives of EBM, EBA and EA were therefore also assessed through the coding analysis and the results are shown in Fig. 1.

While there was no significant distinction between the three

Textbox 1
The geographical division of use

An analysis of the geographical background of the authors showed a difference in popularity among the three concepts. In European publications there is an almost even division of concepts citations (EBM: 38%, EA 35% and EBA 27%), whereas North American authors favour EBM (used in 63% of the North American publications) above EA and EBA (14% and 22% respectively). The more even division in Europe could be a result of the two EU directives MSPD and MSFD, where EBA is the central concept.



concepts when looking at principles (when considering that EBA was often defined by the other concepts), there are more differences when assessing the objectives of the three concepts. The coding showed an overlap of objectives between the concepts on; *ecosystem health*, *sustainability*, *conservation*, *societal benefits* and *economic benefits*, listed according to the number of citations in decreasing order. As illustrated in Fig. 1, EBA and EBM also shared the objective *natural resource management*. In addition, EBM definitions also included objectives of *co-existence* and EBA included objectives of *impact management* and *good environmental status*, the latter being connected to EBA through the MSPD and as a key objective of the MSFD.

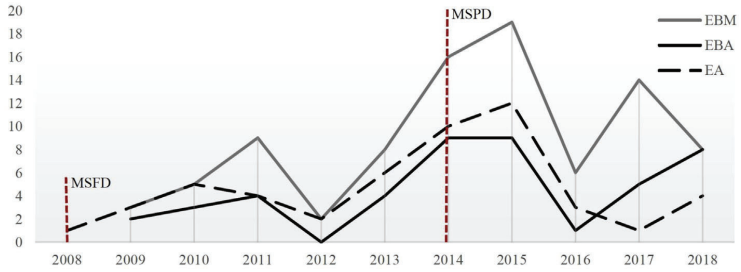
The choice between the three concepts could therefore determine the objectives and outcomes of MSP, as was the case in previously described marine planning cases [19,20]. This depends of course on how the actors define the concept in the MSP process, in terms of i.a. principles and objectives. They can for instance formulate their own definition, refrain from having any definition at all, or use a definition formulated in relevant guidelines. If based on their own definitions, the direction of the MSP process would depend on individual perceptions of the concepts, which, as indicated by the questionnaire, can vary substantially. The results in Fig. 1 might however also be relevant during planning processes, no matter which concept is applied and how it is defined. This could, early in the process, prevent misunderstandings of what the objectives of a particular concept are. For one thing, it could be beneficial to keep in mind that traditionally, EBA is more focused on achieving good environmental status, and EBM is more focused on achieving co-existence than EA is.

4. The power of choosing and defining

Based on the findings in this article, it is clear that the concepts of EBM, EBA and EA are still impalpable and for EBA, the concept is seldom and sparsely defined. The relations between the three concepts are not agreed upon and the conceptualisation of the concepts is getting more and more intricate because of current practices where one concept is defined by a definition of one of the other concepts. In theory, this will increase the level of overlap and could in time lead to two of the concepts being redundant. In reality, this will likely never happen as long as there are practitioners who perceive them as distinct terms, as seen in the questionnaire. A research conducted by Morishita (2008) [34] found that a lack of clear definitions makes it possible for planners or other responsible parties to define the objectives of a concept so that it accommodates to a specific planning process. This could as well be the case when choosing between the three concepts, hereby increasing the power of defining. Such power could be utilised in political decision-making and in the formulation of new policies, for instance by choosing to use the concept that is found the least established, with fewest specific requirements or the concept with the strongest focus on economic growth, depending on the political agenda. Objectives of marine planning are however not only influenced when choosing e.g. EBM over EA or EBA but are also determined by the variations of definitions within each concept. While operationalising EBM, EBA or EA in a planning process by formulating objectives that correspond to the overall objectives of the plan can be highly beneficial for the direction of the planning process, there is a risk that the power that comes with

Textbox 2
The temporal division of use

When depicting the temporal development of citation of EBM, EBA and EA in the literature analysed for this paper (containing explicit definitions of either of the three concepts), three peeks occur. After 2008, when the MSFD was adopted, citations of all three concepts increased, primarily EA and EBM. Then citations increased again from 2012 to 2015, which could be related to the adoption of the MSPD in 2014. The number of EBA-citations overtook EA after 2016 and was in 2018 at the same level as EBM, which could be explained by the increasing work related to the two directives, in which EBA is a central concept.



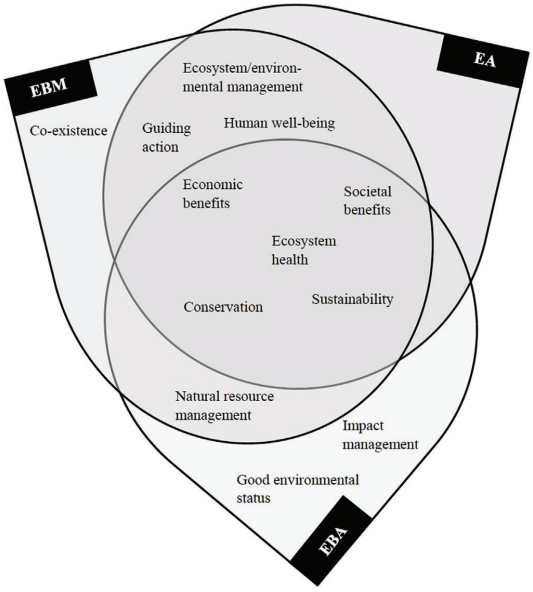


Fig. 1. Objectives of EBM, EBA and EA found through the coding process.

defining and choosing a concept can be misused. This could be done by choosing a specific concept and defining it in order to direct objectives towards a less ambitious outcome or outcomes that are incomprehensive. For instance, choosing to use EA in order not to be met by expectations or requirements that the project should aim for co-existence or good environmental status, as aimed for in EBM and EBA, respectively, could be a way of misusing this power. The risk of this type of practice occurring can be eliminated or at least reduced if the three concepts merge into one with clearly defined objectives and principles. Statements in the questionnaire suggest however that the application of the three concepts can be very similar and lead to similar outcomes as the definition and perception of principles vary between actors, some of which see the three concepts as being close to identical. It can therefore be argued that the foundation for conceptual differences is strongest in legislative documents and guidelines, and that practical application diminishes conceptual differences initially founded in such documents. One could also argue that if objectives of EBM, EBA and EA are formulated in order to fit the overall planning objectives, it would go against the core value of these concepts, of which two include the word "*based*". This word indicate that the concepts should provide the foundation for the rest of the planning process, which involves the formulation of overall objectives, thus basing MSP objectives on objectives of EBM, EBA or EA and not the other way around. Following this, it would go against the overall purpose of EBM, EBA and EA if objectives of these concepts are not clear from the beginning. The power of defining EBM, EBA and EA objectives should therefore not be left to individual planning units.

5. Conclusion

The increasing pressure on marine space and resources has resulted in a growing use of concepts that incorporates ecosystem perspectives into marine planning. This development also entails a growing need for conceptualisation and operationalisation of such concepts, which has so far been inadequate. The three concepts of EBM, EA and EBA were in this assessment found to be the most popular concepts in this context. The three concepts are in many cases used interchangeably or without distinction by MSP researchers and practitioners, which was the case in 38% of the 111 documents coded for this article (or 71% of the 62 documents that include more than one concept). In the conducted questionnaire, 71% of respondents see the three concepts as being neither identical nor completely distinct. The document analysis showed how EBM and EA share the same principles and how EBA is often not defined or defined by EBM or EA definitions. The sparse definitions of EBA could be particularly serious in the EU, as EBA is a central element of the MSFD and MSPD thus playing an imperative role in ensuring good environmental status as aimed for in these directives. Of the found principles, EBM definitions focus on acknowledging interlinkages to a higher extent than the other concepts, while EA definitions put more emphasis on considering ecological/environmental factors and EBA is stronger linked to the practice of cumulative impacts assessments. Differences were also found when it comes to the objectives of EBM, EBA and EA. Objectives of c*o-existence* were only found in EBM definitions, while objectives of *good environmental status* and *impact management* were only found in EBA definitions.

MSP practitioners and researchers interviewed through the questionnaire showed a wide range of (and in some cases opposing) perceptions of the three concepts and how they are connected. These varied and opposing perceptions of the three concepts supports the findings from the literature analysis, which revealed a messy ocean of concepts, principles and objectives. Following this, 67% of the respondents found it confusing to some extent that three so similar concepts are used in MSP processes. This level of confusion proves by itself the need to increase the clarity of what these concepts entail and how they relate to each other. Respondents expected the confusion from having to relate to all three of the concepts could have negative consequences for the planning processes and outcomes.

In order to avoid this, it is imperative that actors and stakeholders in MSP processes are aware of how different perceptions of EBM, EBA and EA can vary both between and within each concept. A heightened awareness makes it possible to question and make requirements for objectives based on EBM, EBA or EA early in MSP processes, and thus create more holistic and comprehensive objectives for holistic marine planning.

Acknowledgements

The author would like to acknowledge and thank all respondents and the contact persons at MSP Research Network, the EU MSP Platform and MEAM for help in disseminating the questionnaire.

Appendix A. Codes

Objectives

- Conservation
- Economic benefits
- Ecosystem health
- Ecosystem/environmental management
- Guiging action
- Good environmental(ecological status (GES)

- Human well-being
- Societal benefits
- Manage impacts
- Natural ressource management
- Co-existence
- Sustainability (Subcodes: sustainable use, environmental sustainability, sustainable management)

Instrumental

- Theoretical
- Strategic
- Multi-sectoral
- Place-based
- Holistic
- Integrated
- Approach
- Framework
- Concept
- Management concept
- Methodology
- Principle
- Process
- Strategy
- Tool

Principles

- Acknowledge interlinkages
- Apply the precautionary principle
- Balance objectives
- Consider cumulative impacts
- Consider ecological/environmental factors
- Consider economic factors
- Consider ecosystem services
- Consider global trends
- Consider social-cultural factors
- Decisions reflects societal choice
- Humans part of the ecosystem

Process

- Adaptive
- Appropriate spatial and temporal boundaries
- Apply best available technology
- Apply local knowledge
- Apply scientific methodology and knowledge
- Collaboration between management agencies
- Stakeholder involvement
- Transboundary

Appendix B. Questionnaire questions and answers

Number of responses:

- Distributed: 69
- Some answers: 20
- Completed: 41

What is your connection with Marine Spatial Planning?

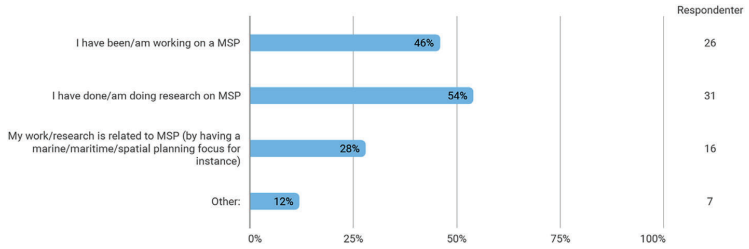


Fig. B.1. Answers to the questions: What is your connection with Marine Spatial Planning?

How would you define your role in MSP?

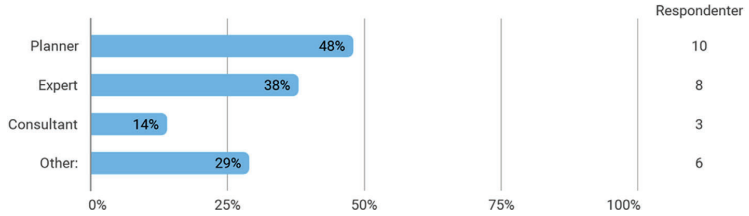


Fig. B.2. Answers to the question: How would you define your role in MSP?2

In which country are you working/studying? (no. of answers)

- United Kingdom (8)
- Germany (6)
- Spain (4)
- Sweden (4)
- Denmark (3)
- Portugal (3)
- Latvia (2)
- South Africa (2)
- France (2)
- Ireland (2)
- The Netherlands (2)
- Cabo Verde (1)
- Romania (1)
- Canada (1)
- Namibia (1)
- USA (1)
- Italy (2)
- Poland (1)
- Malta (1)
- Finland (1)

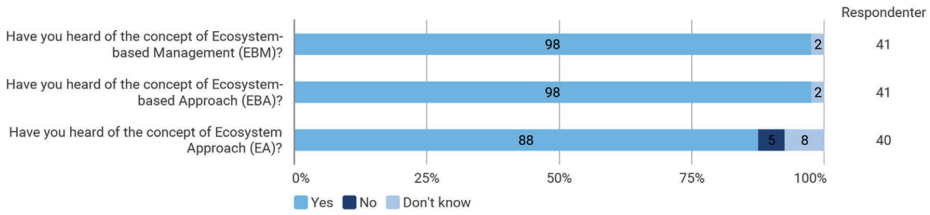


Fig. B.3. Answers to questions of the respondent's knowledge on EBM, EBA and EA.3

Which concept(s) do you use the most often?

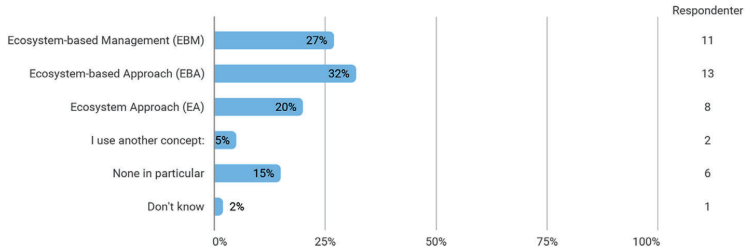


Fig. B.4. Answers to the question: Which concept(s) do you use the most often?4

Does EBM represent a better practice than EA and EBA?

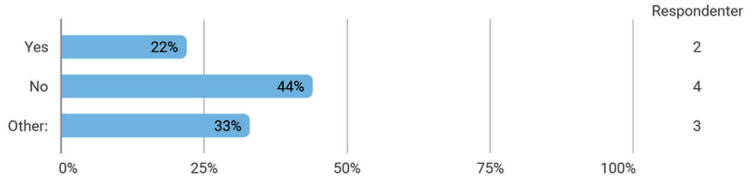


Fig. B.5. Answers to the question: Does EBM represent a better practice than EA and EBA?5

Does EBA represent a better practice than EA and EBM?

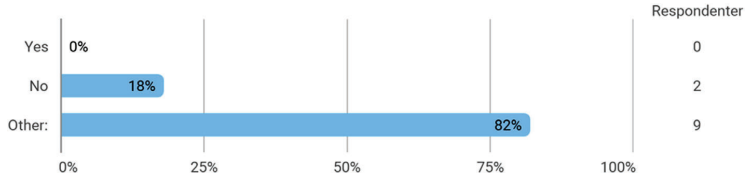


Fig. B.6. Answers to the question: Does EBA represent a better practice than EA and EBM?6

Does EA represent a better practice than EBM and EBA?

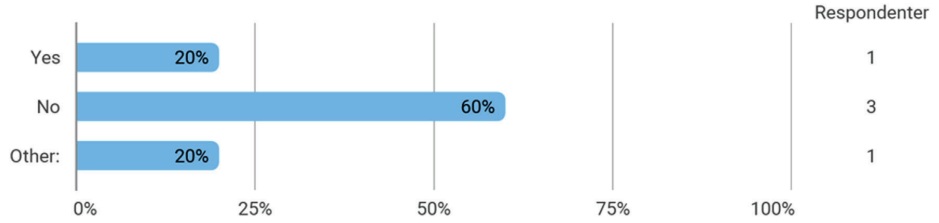


Fig. B.7. Answers to the question: Does EA represent a better practice than EBM and EBA?7

Have you experienced different understandings of one of these concepts? For example a situation where you and someone else had different opinions/perceptions on what EBM, EBA and/or EA entail.

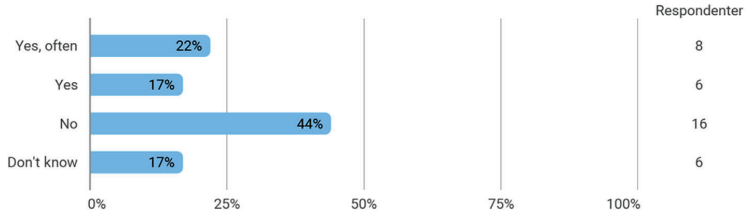


Fig. B.8. Answers to the question: Have you experienced different understandings of one of these concepts? For example a situation where you and someone else had different opinions/perceptions on what EBM, EBA and/or EA entail.8

Do you find it confusing that three so similar concepts exist?

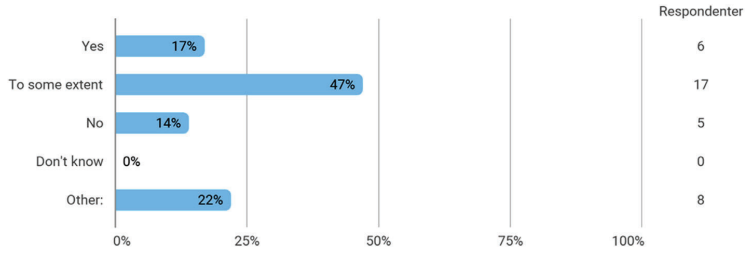


Fig. B.9. Answers to the question: Do you find it confusing that three so similar concepts exist?9

Other, open questions:

How is your work related to MSP?
What is your profession?
Why do you use EBM the most?
Why do you think EBM is better? (please elaborate)
Why do you use EBA the most?
Why do you think EBA is better? (please elaborate)
Why do you use EA the most?
Why do you think EA is better? (please elaborate)
What are according to you the similarities, if any, between the three concepts?
What are according to you the differences, if any, between the three concepts?
Can you give an example or describe a situation where there was a different understanding of one of the concepts? Who/what was involved (a colleague, a publication, another researcher/planner etc.) and how did your understadings differentiate?
How have different understandings of the concepts affected your work? For instance, did you start using another concept more or did it change your own understanding of the concepts?
Why do you think all three of these concepts are used in MSP processes and plans?
What do you think could be the result of having three so similar concepts related to MSP?
What is your definition of an Ecosystem-based Approach (EBA)? Please describe how you would define EBA.
What is your definition of an Ecosystem Approach (EA)? Please describe how you would define EA.
What is your definition of an Ecosystem-based Management (EBM)? Please describe how you would define EBM.
Do you have any other comments on the use of EBM, EBA and EA?

Appendix C. Concepts found in the coded literature

- Adaptive Ecosystem Approach
- Ecosystem Approach
- Ecosystem-based Approach
- Ecosystem-based Adaptive Management
- Ecosystem-based Governance
- Ecosystem-based Management
- Ecosystem-based Management Approach
- Ecosystem-based Marine Management
- Ecosystem-based Marine Spatial Planning
- Ecosystem Governance
- Ecosystem Management
- Ecosystem Management Approach
- Ecosystem Oriented Approach to Management
- Ecosystem Principles Approach
- Ecosystem Services Approach
- Ecosystem Services Valuation
- Integrated Ecosystem Management
- Large Marine Ecosystem Approach
- Marine Ecosystem-based Management
- Marine Ecosystem Management

References

[1] B.S. Halpern, S. Walbridge, K.A. Selkoe, C.V. Kappel, F. Micheli, C. D'Agrosa, J.F. Bruno, K.S. Casey, C. Ebert, H.E. Fox, R. Fujita, D. Heinemann, H.S. Lenihan, E.M.P. Madin, M.T. Perry, E.R. Selig, M. Spalding, R. Steneck, R. Watson, A global map of human impact on marine ecosystems, Science 319 (80) (2008) 948–952, https://doi.org/10.1126/science.1149345.

[2] F. Douvere, The importance of marine spatial planning in advancing ecosystem-based sea use management, Mar. Policy 32 (2008) 762–771, https://doi.org/10.1016/j.marpol.2008.03.021.

[3] S. Katsanevakis, V. Stelzenmüller, A. South, T.K. Sørensen, P.J.S. Jones, S. Kerr, F. Badalamenti, C. Anagnostou, P. Breen, G. Chust, G. D'Anna, M. Duijn, T. Filatova, F. Fiorentino, H. Hulsman, K. Johnson, A.P. Karageorgis, I. Kröncke, S. Mirto, C. Pipitone, S. Portelli, W. Qiu, H. Reiss, D. Sakellariou, M. Salomidi, L. van Hoof, V. Vassilopoulou, T. Vega Fernández, S. Vöge, A. Weber, A. Zenetos, R. ter Hofstede, Ecosystem-based marine spatial management: review of concepts, policies, tools, and critical issues, Ocean Coast Manag. 54 (2011) 807–820, https://doi.org/10.

1016/j.ocecoaman.2011.09.002.
[4] E. Domínguez-Tejo, G. Metternicht, E. Johnston, L. Hedge, Marine Spatial Planning advancing the Ecosystem-Based Approach to coastal zone management: a review, Mar. Policy 72 (2016) 115–130, https://doi.org/10.1016/j.marpol.2016.06.023.
[5] J. Ansong, E. Gissi, H. Calado, An approach to ecosystem-based management in maritime spatial planning process, Ocean Coast Manag. 141 (2017) 65–81, https://doi.org/10.1016/j.ocecoaman.2017.03.005.
[6] R.D. Long, A. Charles, R.L. Stephenson, Key principles of marine ecosystem-based management, Mar. Policy 57 (2015) 53–60, https://doi.org/10.1016/j.marpol.2015.01.013.
[7] J.Z. Koehn, D.R. Reineman, J.N. Kittinger, Progress and promise in spatial human dimensions research for ecosystem-based ocean planning, Mar. Policy 42 (2013) 31–38, https://doi.org/10.1016/j.marpol.2013.01.015.
[8] L. Crowder, E. Norse, Essential ecological insights for marine ecosystem-based management and marine spatial planning, Mar. Policy 32 (2008) 772–778, https://doi.org/10.1016/j.marpol.2008.03.012.
[9] R.E. Grumbine, What is ecosystem management? Conserv. Biol. 8 (1994) 27–38 http://www.jstor.org/stable/2386718 , Accessed date: 28 June 2018.
[10] N.J.I. Rodriguez, A comparative analysis of holistic marine management regimes and ecosystem approach in marine spatial planning in developed countries, Ocean Coast Manag. 137 (2017) 185–197, https://doi.org/10.1016/j.ocecoaman.2016.12.023.
[11] T. Agardy, J. Davis, K. Sherwood, Taking Steps toward Marine and Coastal Management - an Introductory Guide, UNEP, 2011.
[12] S. Söderström, K. Kern, The ecosystem Approach to management in marine environmental governance: Institutional interplay in the Baltic sea region, Environ. Policy Gov. 27 (2017) 619–631, https://doi.org/10.1002/eet.1775.
[13] CBD, The Ecosystem Approach (CBD Guidelines), Secretariat of the Convention on Biological Diversity, Montreal, 2004, https://doi.org/10.1007/BF00043328.
[14] C.N. Ehler, F. Douvere, Marine Spatial Planning: A Step-by-step Approach towards Ecosystem-Based Management, (2009) Paris.
[15] P.M. Gilliland, D. Laffoley, Key elements and steps in the process of developing ecosystem-based marine spatial planning, Mar. Policy 32 (2008) 787–796, https://doi.org/10.1016/j.marpol.2008.03.022.
[16] S. Jay, T. Klenke, H. Janßen, Consensus and variance in the ecosystem approach to marine spatial planning: German perspectives and multi-actor implications, Land Use Policy 54 (2016) 129–138, https://doi.org/10.1016/j.landusepol.2016.02.015.
[17] European Commission, Our Oceans, Seas and Goasts, Achieve Good Environmental Status, (2017) http://ec.europa.eu/environment/marine/good-environmental-status/index_en.htm , Accessed date: 27 March 2019.
[18] R. Sardá, J.F. Valls, J. Pintó, E. Ariza, J.P. Lozoya, R.M. Fraguell, C. Martí, J. Rucabado, J. Ramis, J.A. Jimenez, Towards a new integrated beach management system: the ecosystem-based management system for beaches, Ocean Coast Manag. 118 (2015) 167–177, https://doi.org/10.1016/j.ocecoaman.2015.07.020.
[19] D. Degnbol, Slightly Covered All the Time, Aalborg University, 2012.
[20] D.C. Wilson, The Paradoxes of Transparency - Science and the Ecosystem Approach to Fisheries Management in Europe, Amsterdam University Press, 2009.
[21] K.K. Arkema, S.C. Abramson, B.M. Dewsbury, Marine ecosystem based management- from characterization to implementation, Front. Ecol. Environ. 4 (2006) 525–532, https://doi.org/10.1890/1540-9295(2006)4[525:memfct]2.0.co;2.
[22] C.F. Santos, C.N. Ehler, T. Agardy, F. Andrade, Chapter 30: marine spatial planning, World Seas: an Environmental Evaluation, vol. 2, Academic Press, 2019, , https://doi.org/10.1016/B978-0-12-805052-1.00033-4.
[23] M. Cope, Transcripts (coding and analysis), Int. Encycl. Hum. Geogr. (2009) 350–354, https://doi.org/10.1016/b978-008044910-4.00549-6.
[24] U.S. Federal Agencies, Mid-Atlantic Regional Ocean Action Plan, (2016) http://oceanaction.pt/.
[25] A.M. Kaskela, H. Rousi, M. Ronkainen, M. Orlova, A. Babin, G. Gogoberidze, K. Kostamo, A.T. Kotilainen, I. Neevin, D. Ryabchuk, A. Sergeev, V. Zhamoida, Linkages between benthic assemblages and physical environmental factors: the role of geodiversity in Eastern Gulf of Finland ecosystems, Cont. Shelf Res. 142 (2017) 1–13, https://doi.org/10.1016/j.csr.2017.05.013.
[26] N.O.O. Australian Government, South-east Regional Marine Plan, (2004).
[27] C.F. Santos, T. Agardy, F. Andrade, M. Barange, L.B. Crowder, C.N. Ehler, M.K. Orbach, R. Rosa, Ocean planning in a changing climate, Nat. Geosci. 9 (2016) 730, https://doi.org/10.1038/ngeo2821.
[28] C. Ehler, F. Douvere, Marine spatial planning: a step-by-step approach toward ecosystem-based management, IOC Manual, Intergov. Oceanogr. Comm. Man Biosph. Program (2009) 1–98.
[29] J. Strickland-Munro, H. Kobryn, G. Brown, S.A. Moore, Marine spatial planning for the future: using Public Participation GIS (PPGIS) to inform the human dimension for large marine parks, Mar. Policy 73 (2016) 15–26, https://doi.org/10.1016/j.marpol.2016.07.011.
[30] K. McLeod, J. Lubchenco, S. Palumbi, A.A. Rosenberg, Scientific Consensus Statement on Marine Ecosystem-Based Management, (2005), pp. 1–21, https://doi.org/10.1080/13880290109353975.
[31] K. McLeod, H. Leslie, Ecosystem-based Mangement for the Oceans, Island Press, 2009.
[32] H.M. Leslie, K.L. McLeod, Confronting the challenges of implementing marine ecosystem-based management, Front. Ecol. Environ. 5 (2007) 540–548, https://doi.org/10.1890/1540-9295(2007)5[540:CTCOIM]2.0.CO;2.
[33] CBD, Marine Spatial Planning in the Context of the Convention on Biological Diversity: A Study Carried Out in Response to CBD COP 10 Decision X/29, the Secretariat of the Convention on Biological Diversity, (2012) https://www.cbd.int/doc/meetings/mar/mcbem-2014-04/information/mcbem-2014-04-cbd-ts-68-en.pdf , Accessed date: 20 December 2018.
[34] J. Morishita, What is the ecosystem approach for fisheries management? Mar. Policy 32 (2008) 19–26, https://doi.org/10.1016/j.marpol.2007.04.004.

Paper 2

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An ocean of ambiguity in Northern European marine spatial planning policy designs

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ABSTRACT

Marine spatial planning (MSP) in Europe is in a paradigm shift as all (coastal) European countries now have established practices for the production of marine spatial plans. Though international guidelines and an EU directive for MSP provides policy frameworks, the formulation of national policy designs for MSP remains a national responsibility resulting in vastly different practices. Focusing on three Northern European countries; Denmark, Germany and Norway, this paper presents examples of how national policy designs for marine spatial planning are structured, and how the current practice in each country is influenced by local planning cultures. This mapping gives insights to a number of challenges facing planning authorities when planning for sustainable development. Ambiguity dominates the framework of marine spatial planning and the central sustainability concepts it contains. This paper gives voice to the planning teams, as they are key-players in generating meaning in this ocean of ambiguity, giving insights to their understanding of sustainability in the planning of futures for sustainable seas.

1. Introduction

As the pressure from human activities has increased and diversified, the spatial management of activities at sea has developed. Over the last 30 years this development has led to the practice of Marine Spatial Planning (MSP) [1], which is a '*public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process*.' [2]. In Europe, MSP has been practiced since the beginning of the century. 'Pioneering' states, such as Germany, the Netherlands, Norway and Belgium, were the first European countries to practice MSP, based on their own administrative structures and policy designs and existing planning cultures. In 2014, the EU directive for MSP (MSPD, 2014/89/EU) was enacted. According to the directive, "*The main purpose of maritime spatial planning is to promote sustainable development (…)*", and in order to ensure sustainable development: "(…) *maritime spatial planning should apply an ecosystem-based approach*".[1] The focus on sustainable development is further emphasised in the MSPD by having the word '*sustainable*' written 25 times in the 11 pages of the directive. Since 2014, 'pioneering' EU member states have had to adapt their policy designs and MSP practices to the requirements in the directive. Member states without MSP experience before 2014, such as Denmark, Ireland and Estonia, have to build new MSP policy designs and planning practices in line with the requirements of the directive [4,5]. However, the requirements are loosely formulated and it is emphasised that the directive "*shall not interfere with Member States' competence to design and determine the format and content of that plan or those plans.*" (Art. 2). The flexible framework offered by the directive mirrors a general trend of legal frameworks with environmental governance purposes, in that they are increasingly being formulated more ambiguously and open to interpretation [6,7]. The ambiguity within legal frameworks for MSP and the concepts it contains, paves the way for a wide variety of different forms of formal compliance (formulation of national policies) and practical compliance (application and execution of the rules in policy practices, in this case the MSP processes and the making of plans) (cf. [8–10]). Hassler et al. (2019)

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[1] The MSPD uses the term 'maritime spatial planning', which has encouraged an increasing use of this term, especially within the EU, however in this paper, the term 'marine spatial planning' is used, as this is more recognised and applied in MSP research [3].

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found that processes of MSP vary significantly between neighbouring countries. They found substantial diversity in how countries balance and promote sustainable development objectives, which was found to be particularly challenging [7]. Sustainability objectives and concepts are frequently used in MSP frameworks, including the MSPD, which includes a variety of sustainability concepts, such as sustainable co-existence, sustainable decision-making, sustainable management, sustainable tourism and sustainable extraction, in addition to those of sustainable development, sustainable growth and sustainable use.[2] Research has found that the vagueness and ambiguity of sustainability concepts [11,12], leave room for many different and sometimes conflicting definitions of sustainability [7,13,14]. Within planning practices, the lack of common interpretation of sustainability concepts causes misunderstandings and disagreements [11] as well as conflicts in transboundary corporation [7,15]. Sapountzaki and Karka [16] found that sustainability objectives in spatial planning in Greece did not go beyond political manifestos and therefore did not lead to sustainable development. This could, according to Hassler et al. [7] be the result of lacking guidance on how to tackle and balance sustainability objectives. The same researchers found that the lack of guidance on balancing objectives could lead to an interpretation of sustainable development that was based on national interests instead of overarching sustainability principles [7]. While the growing diversity of sustainability concepts might be a response to the increasing level of activity at sea as well as the holistic and broad nature of MSP policies, the meaning of these sustainability concepts, as well as how to operationalise them, are unclear [12,17]. As of now, all European countries have marine spatial plans in place or are well in the process of preparing plans in order to meet the MSPD deadline of March 2021. The objective of this study is twofold. First, to give insight and to explain the differences in three Northern European MSP frameworks, by analysing the different policy designs and national planning cultures. Second, to give insights into how planning teams in the selected countries define and operationalise sustainability in MSP processes and plans.

1.1. Policy formulation in planning cultures

The formulation of national policies for MSP not only depends on their prior experience in MSP, but also on their institutional planning context. In general, the process of policy implementation entails several stages, which involve groups of actors with different agendas and interpretations of what the role of MSP is. In this paper, we make use of the theoretical framework of policy implementation as formulated by Winter and Nielsen [18,19]. According to their framework, the implementation of policies consists of four stages: the policy formulation, the policy design, the actual implementation and the implementation outcome. The *formulation* of a policy is usually carried out by a group of actors with different interests and agendas. Studies have found that in processes of policy formulation, policies are often ambiguously formulated in order to accommodate as many agendas as needed [20]. Ambiguity can in this case be found in relation to either goal setting or formulation of means [21]. While policy formulation facilitates agreement between parties that might not otherwise be able to agree on the formulation of a policy, ambiguous policies are often implemented without a shared perception of its meaning and desired outcomes [20]. The process of policy formulation leads to *policy designs*, which in most cases specify parameters such as the authority responsible for its implementation, available resources (for example budgets and data infrastructure) and potential analytical and policy instruments [22]. The third stage of policy implementation is the actual *implementation process*, which is carried out by a network of actors, including management and 'fieldworkers' within the responsible implementation authority. Fieldworkers are forced to navigate with potential policy ambiguities and therefore play a crucial role in the implementation process. In his ambiguity-conflict matrix, Matland explains how policies with a high level of ambiguity can either lead to experimental implementations, where outcomes depend on the actors and resources available in the implementation process, or symbolic implementations if the level of conflict among actors is high (cf. [21]). Furthermore, Matland argues that high level of policy ambiguity leads to heterogeneous implementations, which European MSP practices have been found to be examples of [7]. The last stage of policy implementation is the *implementation results*, which consist of both immediate outcomes and the final outcome that can be compared with policy objectives stated in the policy [19]. Studies of policy implementation initially ascribed any lack of successful outcomes to the policy design, while newer research ascribed any lack of success to the implementation process itself [22]. In reality, neither one of the policy implementation stages can alone explain a failed outcome. Successful implementation depends on both the policy formulation, policy design and the implementation process [22]. While all stages of policy implementation are comprehensive and highly complex, an in depth investigation of all stages would extent the length of a regular paper. For this reason, this paper focuses on the processes of policy formulation and design in three MSP cases, while the actual implementation and implementation outcomes are not investigated in this paper. Concerning EU member states, one can argue that the policy implementation process consists of three policy formulation processes, each resulting in a specific policy design. The first process is the formulation of the MSPD, which took place in the EU commission in the years leading up to 2014. The second and third policy formulation processes are the transposition of the MSPD into national legislation and the MSP process itself, respectively (see Fig. 1). For non-EU states as well as EU member states, the exact number of policy formulation processes and policy designs varies depending on the national process and number of national MSP policy designs.

In most cases, the MSP process consists of interactions and negotiations between the planning team on the one hand and involved stakeholders e.g. from maritime sectors as well as agencies and municipalities on the other. Within the planning team, certain traditions and values are embedded. This is also referred to as planning culture, where planning, as a social and interactive process, involves objectives, values and norms. The actors involved in planning processes are conditioned by these norms, the local and professional cultural setting and the system of planning they act in Ref. [23,24], which affects *"the interpretation of planning tasks, the way of recognizing and addressing problems, the handling and use of certain rules, procedures and instruments, or ways and methods of public participation"* [23]. Being a relatively new subject in planning literature, the definition of planning culture is contested [25]. In this paper, planning culture is considered as a combination of societal and professional cultural aspects shared by a group of planning practitioners. Any planning culture is inevitably affected by other professional and societal cultures on different geographical scales and can be viewed as a product of various factors such as geography, socioeconomic developments and history, which has been found to be a highly influential factor in shaping planning cultures [24,26,27]. Studies of planning cultures often distinguish between tangible and intangible cultural aspects [23]. Tangible (or 'visible') cultural aspects includes the administrative structure, procedures and tools (such as frameworks, analytical models and software) applied in the planning process, whereas intangible aspects of planning cultures are more invisible and consist of values, norms, habits etc. [28]. This paper focuses on the former, more tangible, aspects of planning cultures. Tangible, cultural aspects such as administrative structures and procedures are also referred to as *formal institutions,* which have been central to implementation research since the 90's [29]. In their research on transitions of European policies, implementation scholars of the late 90's found "(…)*rules and existing institutional and regulatory traditions as one of the central factors determining implementation performance*" [29]. Many implementation studies have found that policy implementation can be obstructed if policies are

[2] Directive 2014/89/EU.

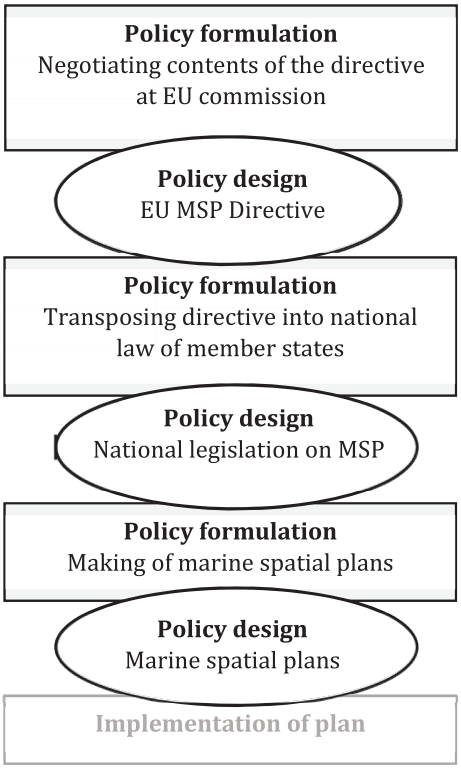

Fig. 1. A schematic overview of policy formulation processes and designs that influence the outcome of MSP. Inspired by Winter and Nielsen 2008.

incompatible with national institutional arrangements [10].

1.2. A short glimpse of European planning culture

While MSP is a relatively new activity, many of its characteristics stem from terrestrial spatial planning, which stems from practices in land management and urban planning dated all the way back to Mesopotamia and Ancient Greece [30,31]. Most often, however, the development of urban and regional planning is perceived within the timeframe of the last century, when the term 'planning' was established and the practice of planning evolved [32–34]. The development of planning cultures in Western Europe can be perceived in three periods. The first period, often referred to as the 'golden age of planning', began in the years following World War II. Here, planning practices took off and developed, using the tools that had been invented during the war, such as planning programming and cost-benefit analyses [35]. In the sixties, spatial planning was increasingly strategic in many European countries, although the strategic approach died out at the end of the seventies [36]. During this period, the planning profession was increasingly faced with criticism towards the centrality and eliteness of the planning profession. With time, this led to more bottom-up and participatory practices and a new approach to strategic planning developed [36]. The third and current period of planning can be seen as the era of integrated planning with an increasing application of the 'spatial planning' concept. Spatial planning is the planning for the future, spatial, distribution of activities and has increasingly put focus on sectoral integration and sustainable development objectives [30,35]. In 1997, the EU Commission compared the planning system of 15 European countries and found substantial differences between Northern and Southern European traditions within spatial planning [37]. The dominant tradition in Northern Europe was found to be an integrated approach where spatial planning is hierarchically structured from national to local level. The Southern European tradition was found to be more focused on urban planning with a more complex planning framework. In an examination of planning systems in Western Europe, Larsson ([38]) found differences between all countries in the structuration and contents of their national planning systems, although he also found substantial similarities among some of the countries. One key similarity was that the national government, in cooperation with the parliament, makes decisions for the planning systems, structures and instruments at different regulatory levels. Oxley et al. ([39]) found the same similarity in their comparison of national planning systems in Northwest Europe. In addition to this common feature, Larsson found great similarities between the planning systems in Nordic countries and Germany, particularly related to the practice of having long-term local plans as frameworks for development projects [38]. Even though some similarities exist among national planning systems, no two countries have identical planning systems or traditions. In a study of Nordic planning traditions, Hall ([34]) even questions whether it makes sense to apply the generalising term 'Nordic' in his evaluation, e.g. due to vast differences in planning traditions. Hall finds, however, that due to the geographical proximity and shared histories, the planning traditions of Nordic countries have evolved through mutual inspiration among the countries, in addition to inspiration gained from none-Nordic countries such as Germany [34]. The planning culture in today's Europe is characterised by less hierarchical planning processes with less distinct separation between public and private actors. Spatial planners are faced with increasingly complex and 'wicked' problems that sometimes require innovative solutions, which traditional planning structures (such as legal frameworks, administrative structures and planning tools) struggle to deliver [35]. While the EU has no spatial planning competence, it has played a significant role in building a framework for spatial planning in EU member states [26,40,41]. In their comparative study of member states' planning systems, the EU Commission found that a range of factors influence national arrangements of spatial planning: "These *factors include historical and cultural conditions, geographical and land use patterns, the constitutional, administrative and legal framework, levels of urban and economic development, and political and ideological aspirations.*". They found that these factors have resulted in widely diverse national systems of spatial planning [37]. The legacy from urban and regional planning has created a good foundation for MSP practices, although it has been argued that MSP in some cases relies too much on traditions, values and tools from terrestrial planning cultures. Gazzola and Onyango (2018) stress that although it is important to build on terrestrial planning experiences, these will not be adequate for MSP, which has to adapt and develop in accordance with the marine context [31]. By comparing MSP policy designs of three countries in terms of their structure and use of sustainability concepts, this paper evaluates the role and development of planning cultures as well as how planners from different planning cultures perceive the concept of sustainability. This evaluation seeks to answer the question; how do MSP policy designs vary in structure and in their framing of sustainability, and what understanding of sustainability have MSP planners created within this context?

2. Methodology

This paper compares national policy designs and policy formulation processes for three Northern European MSP cases in Denmark, Germany and Norway. The assessment of different MSP policy designs and interpretations of sustainability concepts was carried out as a comparative case study of three Northern European countries; Denmark, Germany and Norway. The three countries were selected based on three parameters: 1. Geographical location and proximity to each other, 2. Different

experiences in MSP 3. Available knowledge and knowledge gaps. First, the geographical scope of the evaluation was set to be Northern European and it was preferred that the selected cases should be proximate to each other, in order to minimise the influence of geography on the planning cultures in focus. Secondly, it was prioritised to include countries with different experiences in MSP, in order to facilitate a comparison of different policy designs. Thirdly, it was also important to ensure availability of key data and ensure that the cases had not already been part of similar evaluations. Based on the three parameters, Denmark, Germany and Norway were chosen. The three countries, while being geographically and historically close have very different MSP histories, and thus provide for an interesting comparison of MSP policy designs. Denmark is developing its policy design following the EU directive. Germany, one of the pioneering countries, had an MSP policy design and practice in place before the EU directive [42] and Norway, another pioneering country, has built and maintained its MSP policy design and practice outside the framework of the EU directive as Norway is not a EU member state. In this perspective, the three cases cannot be generalised and are not representative for European countries as a whole, but are perceived as diverse, Northern European cases all pointing at specific themes which invoke a general interest [43]. Both legal and non-legal documents that form the policy design of the three countries were located with the assistance of three planners, one from an MSP team in each country (see documents in appendix A).[3] These documents are used to illustrate the policy designs for the three countries. They were also analysed for their use of sustainability concepts and potential definitions of sustainability or guidelines for how to interpret and plan for sustainable development. The legal documents were coded in NVivo by searching for sustainability concepts. These were located by using search words containing sustain, bæredygtig, bærekraftig, berekraftig, and nachhaltig. As a supplement to the document analysis, the three planners were interviewed with the purpose of collecting additional and in-depth information on the national policy formulation processes and policy design (national MSP legislation and structure of MSP processes), as well as to examine the interpretation of sustainability concepts and the potential influence and characteristics of planning cultures. The three planners have all been involved since the beginning of the corresponding national MSP process. They were chosen due to their insights in the MSP process as well as the planning culture and perceptions of sustainability within the planning teams. The analysis is focussed on the internal process in the planning authorities and the planners were asked questions as representatives of this, thus the analysis does not focus on the diverse set of actors involved in the process outside of the authorities. In order to ensure interviewee anonymity, the interviewees are referred to as Danish, German and Norwegian planner, respectively. The interviews were semi-structured and were performed face-to-face or via telephone, and followed up by either a follow-up interview and/or e-mail correspondence. These were later transcribed and categorised through two rounds of coding. The first round was data-driven and was used to facilitate the formulation of code categories based on the content of the interview. The second round then used the categories to double check the coding. Some categories were removed, reformulated and most categories received additional coded statements. This process led to a list of 19 themes (see appendix B), all related to the implementation of the directive, the planning process or the concept of sustainability. The coded statements were then interpreted and narrowed down in order to have a more condensed coding result, allowing for a better overview while still having the extended version as reference. The themes of *Planning culture*, *Understanding sustainability* and *Planning for sustainability* and the themes relating to these were chosen for further analysis, as they address issues related to the influence of planning culture and the interpretation and incorporation of sustainability concepts in MSP.

[3] For Denmark and Norway, MSP is centralised and carried out by one single team, whereas in Germany, there are MSP teams for each of the three Bundesländer and for the two EEZ areas.

3. Results

The following sections include a brief presentation of the three national policy designs followed by an evaluation of how sustainability is framed and perceived in MSP policy designs and in MSP teams as well as perceived challenges in planning for sustainable development.

3.1. National policy designs for MSP

As illustrated in Fig. 2, the policy formulation processes that led to the national policy designs and the MSP processes varies in structure. While the German framework for MSP has been shaped through four stages of policy formulations and designs, the Danish process involved three and the Norwegian process involved two policy formulation processes and designs.

While Denmark has a separate policy design for MSP and separate marine spatial plans, in Germany and Norway these are integrated into other planning frameworks. In Norway, this is addressed through a policy design for marine management plans, which functions as both a marine spatial plan as well as a marine strategy, and in Germany, MSP within 12 nm (in the *Bundesländer*) is part of the regional planning framework [42]. Germany and Norway both have long traditions of MSP (with plans finalised first time in 2003 and 2006, respectively), compared to Denmark, where MSP was initiated by the formulation of the MSPD in 2014. The timing of when MSP was initiated has influenced the complexity of the national MSP policy design. While Denmark enacted one single law (very similar to the formulation of the MSPD), MSP in Germany is governed by five different legal documents, and MSP in Norway is governed by seven legal documents (see Table 1) (for details on the documents, see appendix A).

Another significant difference among the three policy designs (see Table 1), is whether the plan is legally binding or whether it is only used as a guiding, non-legal, document. In this case, Denmark is the only one of the three countries, where the marine spatial plan is enacted as a legal document, making the probability of having an influential implementation higher than if the plan was non-binding.

3.2. Policy formulation in planning cultures

Although the planning cultures of the three countries might be more similar than if compared to non-European planning cultures, some tangible cultural differences can be seen within the planning cultures of the MSP authorities in the three countries. These differences are strongly linked to the type of competent authority in charge of the MSP process. While the planning team in Norway is part of the Ministry of Environment, the Danish team is part of the Danish Maritime Agency. In Germany, MSP is split between the regional federal states (Bundesländer), who cover the territorial seas and the federal republic, who covers the EEZ areas. This involves in total four different agencies (as listed in Table 1). Somewhat roughly categorised, the type of the Danish, German and Norwegian MSP authorities can be said to be economic, general spatial planning and environmental, respectively. These identities each entail different cultural aspects of e.g. planning objectives, approaches and tools. In the Norwegian MSP process, this is exemplified by giving a more central role to environmental impact assessments compared to the other two countries. Early in the Norwegian MSP process, environmental impact assessments are conducted for each maritime sectors and later combined into a cumulative impact assessment, whereas in Germany and Denmark environmental impacts are assessed through a strategic impact assessment, once a draft plan has been formulated. In Germany, the regional plans (made by the *Bundesländer*) are developed by planning agencies, which are both responsible for terrestrial and marine planning. This institutional set up encourages a culture of closer

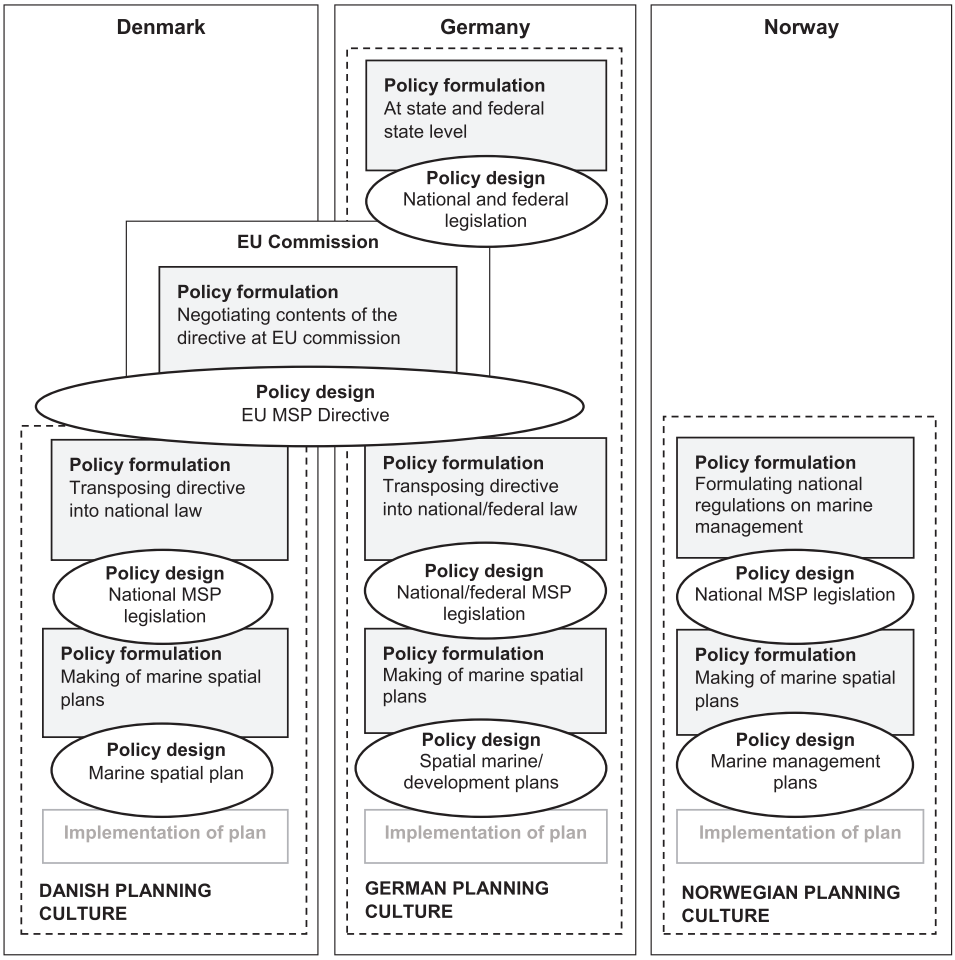

Fig. 2. The process of policy formulation and design for MSP in Denmark, Germany and Norway. Loosely based on the framework offered by Winter and Nielsen [19].

coordination between the planning for land and sea areas. Also, the administrative structure of the German MSP policy design is highly influenced by the structure of the federal system, which has been found to lead to a successful implementation with a high level of practical compliance with implemented policies [10]. In a study of the level of decoupling between formal and practical compliance with 24 EU directives, Zhelyazkova et al. [10] found Germany to be the country with the lowest level of decoupling. The authors expect this could be due to a lower level of power of higher-level administrative actors over the implementation process [10]. The administrative structure of the German MSP policy design is thus an inherent aspect of not just the MSP planning culture in Germany but the German planning culture in general. In Denmark, because the Danish Maritime Agency has limited experience in spatial planning, they are developing a planning culture without any spatial or environmental planning legacy. It is however not yet possible to know (due to the status of the Danish process) to what extent the professional culture at the agency will influence and shape the Danish MSP culture. The interviewed planners from Germany and Denmark shared the perception that MSP in general is a very international and transboundary activity, and that national planning cultures therefore have less influence on MSP than on other types of planning activities. Indeed, within the Danish MSP team, planners in neighbouring countries are perceived as a type of colleagues, while still recognizing that some cultural differences exist in national MSP processes. The German planner emphasised the influence of EU and suggested that national MSP practices with time are homogenised due to a common European tradition: "*I guess for the European context, all of our countries they anyhow go for a sustainable way of spatial planning. This is within our tradition and today (…) also the way of doing it within our societies*". The shared perception of the Danish and German planner of a collaborative end homogenised MSP practice could however be the result of regional circumstances. Both Denmark and Germany have MSP activities in the Baltic Sea region in which there is a continuous and close collaboration on a long list of projects and forums.[4] In addition, Stead

[4] Collaborative activities include HELCOM, VASAB, BalticLINes, Interreg Baltic Sea Region, EU Strategy for the Baltic Sea Region, Pan Baltic Scope and BalticRIM. https://www.msp-platform.eu/sea-basins/baltic-sea-0.

Table 1
The national policy designs for MSP in Denmark, Germany and Norway [44].

	Denmark	Germany	Norway
Is the plan legally binding?	**Yes**, the plan is enacted as a legal document.	**Yes**, to some extent, mainly in terms of licencing. [44]	**No**
Is the plan a separate marine spatial plan?	**Yes**	**No**, for the regions. The plan is part of the regional plan (which includes the territorial waters (12nm from baseline)). **Yes**, for the exclusive economic zones (EEZ) (from 12nm and out).	**No**, spatial planning is combined with a marine strategy in integrated marine management plans.
No. of legal documents for national MSP policy design[4]	**1**	**5**	**7**
No. of planning teams working on national MSP.	**1**, at the Maritime Agency.	**4**: One for the EEZ-plans at The Federal Ministry of Interior, Building and Community (BMIBH) and one for each of the three coastal *Bundesländer* (In Schleswig-Holstein: Ministry of the Interior, Rural Areas and Integration; in Mecklenburg-Vorpommern: Ministry of Energy, Infrastructure and Digitalization; in Lower Saxony: Ministry of Food, Agriculture and Consumer Protection)	**1**, at the Ministry of Environment.
No. of spatial planning areas	**1**	**5**	**3**

(2012) suggests national differences in factors such as history and culture (political, professional and administrative) potentially prevent any harmonisation among European spatial planning arrangements, and highlights planning cultures as one of the main forces against convergence [40]. Furthermore, the aforementioned differences in identities of MSP authorities suggest, that national planning cultures have a significant influence on policy designs.

3.3. Dilution of sustainability concepts

While the MSPD has a substantial inclusion of sustainability concepts (mentioned 25 times in the 11-page document), the national MSP policy designs put less emphasis on sustainability concepts (for legal documents see appendix A). The Danish policy design contains the word 'sustainable' five times (five-page document), predominantly related to economic objectives e.g. through terms such as sustainable development, growth and use. This can be seen as a reflection of the identity of the responsible authority (the Maritime Agency), which is also predominantly economical (being part of the Ministry of Industry, Business and Financial Affairs) and the lack of previous experience in holistic planning. The Norwegian policy design contains seven uses of sustainability concepts (128-page document), of which the predominant concept was 'sustainable use'. Other concepts include 'sustainable protection', and 'sustainable management of living resources'. The application can thus be said to be both oriented towards economic and environmental objectives. Finally, the German policy design contains 41 uses (99-page document), which is the highest count among the three policy designs which has facilitated a more diverse use of sustainability concepts. Like the Danish framework, sustainability concepts in the German policy design predominantly includes 'sustainable development', but also 'sustainable fishing', 'sustainable economic growth', 'sustainable public services' and 'sustainable protection'. While the MSPD has 'sustainable development' as its key objective, this could explain why Denmark and Germany both favour this objective and why Norway favours another. The Norwegian preference of 'sustainable use' could be explained by the embedded culture of using marine resources in Norway. The overall trend is, however, that none of the three national policy designs has the same level or diverse use of sustainability concepts as the MSPD. The reduced application of sustainability concepts could indicate that the actors in national policy formulation processes found sustainability concepts too ambiguous for further application. The document analysis of the three policy designs showed a general lack of definitions and guidance on what sustainability concepts mean and how to plan for them. The German policy design does involve some guidance for the planning teams. The policy design of the German MSP process consists of a guiding document, called *Concepts and Strategies for Spatial Development in Germany*, which was formulated after the *Standing Conference of Ministers responsible for Spatial Development in Germany*. This document seeks to clarify which actions to take in spatial development and highlights specific actions for how to ensure sustainable use of coasts and seas through MSP. In addition to these guidelines, the Spatial Planning Act (Raumordnungsgesetz) clarifies that the guiding principle of spatial planning is sustainable development *"(…) in which the social and economic demands on space are reconciled with its ecological functions leading to a permanent, spatially balanced order with equivalent living conditions in the planning areas."* (Translated). Furthermore, it clarifies that sustainable development is ensured through an ecosystem-based approach. The influence of definitions and guidelines, however, ultimately depends on whether (and to which extent) planners find them useful. The interviews revealed varied perceptions and definitions of sustainability concepts in the three planning teams. When asked about how the responsible planning authority defines sustainability, the German planner had the most elaborate response, while both the Danish and Norwegian planner expressed little reflections of the meaning of sustainability. This reflects to some extent the word count presented above, in which the German policy design included most sustainability concepts (41 in 99 pages). The German planner referred to the definitions and guidelines found in the national (republic) policy design, as the foundation for his understanding. In addition, the understanding of sustainability within the planning team had been enhanced through

ongoing discussions, both among colleagues and with stakeholders. The team is supported by guidelines formulated by the ministers (for instance in the *Concepts and Strategies for Spatial Development in Germany* document). These guidelines however, are predominantly focused on growth and not the achievement of a sustainable development. The German planner perceives the framing of sustainable development in the *Concepts and strategies* document as being somewhat 'utopian': *"it is a bit like peace all over the world"* and it is his perception that this decreases the applicability of the concept. In spite of the lack of applicability of the 'utopian' sustainability definition, the German planner perceives the ambiguity of the sustainability concept as a strength: *"(…) this is also part of the success of that concept. That many people can find themselves within that concept, because you can fit very different things in there."*. In addition to the overall ('utopian') sustainability definitions offered by the ministers, the German team also experience ongoing negotiation of defining sustainability with stakeholders: "*some of them fight for the economy, some of them fight for the environment and some of them fight for social well-being (…) there is always a constant process of negotiation of what sustainability means"* (German planner). When the interviewed planners were asked how they define sustainability in their planning teams, the ambiguity and vagueness of the concept was demonstrated. The Norwegian planner gave no definition but expressed a wish and need for a clear definition, which again reflects the word count. With only seven references to sustainability in 128 pages, this indicates an inadequate foundation for generating an understanding of sustainability. The Norwegian MSP team had previously debated how to define sustainability, however without obtaining a clearer definition: *"I tried to challenge some of my colleagues that were close to the general sort of sustainability work, and I thought I was in lack of a very good answer of what is … a strict definition"* (Norwegian planner). Despite this lack of definition, the planner explained that usually, within the team, they refer to sustainability as being three-dimensional in focusing on environmental, social and economic aspects, which is also the case for the German planning team. The Danish planner also refrained from giving an explicit definition of sustainability: *"We look very much at how it is understood in the directive"*, but stressed that they continuously work on building an understanding of the concept of sustainability. The lack of conceptual perception of sustainability could be a result of the short history and limited experience within MSP and holistic planning in general in the Danish team. The German planning team have already been through a long process of building this understanding, and have experienced a decreasing value and meaning of using sustainability concepts. They therefore experienced an increasing need for a new concept: *"there was the feeling that this concept* (sustainability)*, at the end of the day, didn't help somehow … that there is the need for something new and that the ecosystem approach may be just that – a new concept"*. The German planning team have found that the ecosystem-based approach (EBA) might be the new concept to meet the experienced need for a new sustainability concept. In the MSPD, an ecosystem-based approach (EBA) is likewise linked to the achievement of various sustainability concepts, as the directive requires member states to take an EBA in order to *"(…) promote the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources (…)"*. Seeing the concept of EBA as a substitute for sustainability could indicate the inapplicability of sustainability concepts due to their ambiguous nature. While the role and application of the EBA concept is growing, this does not indicate that the concept is clear and unambiguous. Through interviews with actors in a German MSP case, Jay et al. ([45]) found the general perception of the EBA concept to be that the concept is open to various understandings, and very few respondents offered clear definitions of the concept. Similar perceptions were found for the planners interviewed for this paper. In both the German and Danish planning teams, planners are struggling with how to understand the EBA concept and the role it should play in MSP. The Danish planning team engages with the responsible authority of the national marine strategy (The Environmental Ministry), in order to discuss and conform their perceptions of EBA. While the concept of EBA is still debated and disagreed upon in terms of key principles and functions of the concept [46], the process of establishing a common understanding of the concept might go on in many countries. The German planning team had similar discussions both internally and on federal state and federal republic level, on what EBA means, whether it is different from sustainability or part of it: "*this new term of an ecosystem approach was something that we all had a question mark to somehow; is that something new? Is that a new quality of sustainability?*". The German planner emphasised, that by concluding that EBA might be an element of sustainability, they put emphasis on ensuring a healthy environment in order to balance the strong focus on development and growth. Common to the three planning teams were the ongoing discussions and evaluations of how to understand and define sustainability concepts. This generation of understanding is imperative to the outcome of MSP, as it enables the planning process to direct actions towards sustainable development. However, building a conceptual understanding of sustainability concepts is only one of many challenges in the process of ensuring sustainability through MSP.

3.4. Challenges in ensuring sustainability

When asked about how to ensure that MSP leads to sustainability, the interviewed planners agreed that environmental impact assessments play an imperative role. While the Danish and German process is obliged by EU regulation (Directive 2001/42/EC) to perform a Strategic Environmental Impact Assessment (SEA), which includes the assessment of cumulative impacts, Norway has its own system. This system is however very similar to the EU regulations and similarly includes requirements for SEAs. The Danish planning team use an external consultancy for the SEA, whereas the German team conducts the assessment themselves. Following the SEA directive, SEAs are usually conducted on a draft plan, i.e. after the draft has been made (Directive 2001/42/EC). For the Norwegian process, current impacts are assessed, first within sectors and then combined to a cumulative impact assessment. Both phases of impact assessments (sectoral and cumulative) are central to the Norwegian MSP process and the formulation of the Norwegian draft plan. In relation to the assessment of impacts, the Danish and German planners both expressed a challenge with data supply. When it comes to assessing cumulative impacts, the German planning team experiences an incomplete data coverage for the planning area, which challenges the practice of a modelled cumulative impact assessment. In addition, the Norwegian planner emphasised the challenges in measuring sustainability objectives such as sustainable use, and the Danish planner stressed the dilemma in assessing impacts of potential activities, when it is uncertain how much of the appointed areas will end up being utilised by activities: *"so the areas we appoint to an activity (…) it is a bit vague. You don't know where the park will be placed. You might not even know how big it's going to be (…) and I think it's like that with many areas"*. She also referred to experiences from terrestrial planning as another argument for why the assessment of planned, potential activities is challenging: *"this is also the experience from terrestrial planning, that many plans don't result in anything"*. This reference further indicates the relation and transfer of experience between terrestrial planning and marine spatial planning as suggested by Gazzola and Onyango [31]. The Danish planner did however stress the importance of not picking up the current practice of terrestrial planning: *"and what can you learn from that (terrestrial planning) (…) do not think that you should start off where terrestrial planning has ended up after 80 years"*. The different levels of experience within MSP are evident in the challenges the planning teams face. Carrying out their first MSP process, the Danish planning team mainly focuses on how to understand and perform MSP, how to find and use data, as well as how to define key concepts, such as EBA. In this regard, the planning team could have used some general guidance on MSP: *"But it is not clearly indicated in the directive 'how-to-do'"* (Danish planner). In the German planning team they struggle more with a lack of available areas, conflicts with citizens and stakeholders, as well as how to avoid disturbance of

the MSP process due to a change in government. The Norwegian planning team face similar challenges as the German group, especially in terms of how to solve conflicting interests among sectoral stakeholders as well as how to homogenise the legal frameworks across sectors and geographic locations: *"You have a lot of emerging new activities in the sea areas (…), and I think the need for more cross-sectoral measures and the legal basis for them can be a challenge"*. In addition, the Norwegian planner specifically mentioned being challenged by a lack of legal framework for marine protected areas (MPAs) in the EEZ, while there is an established legal framework for MPAs in the territorial zone (12 nm). The challenges of how to balance the interests of the different sectors (including new, developing, activities such as aquaculture and deep-sea mining) was shared by the interviewed planners. Different regulations and practices within the sectors challenge the integration and cross-sectoral management guided by the MSP processes: *"for instance with aquaculture, you can make compensating actions, and then there are other (activities) where you don't. And then there are sectors where you do environmental assessments and then there are other sectors, like shipping, where you don't"* (Danish planner). There was however also the perception that this challenge is at the very centre of MSP and a key reason for why MSP is necessary in the first place. While some of these challenges are unavoidable and inherent to the MSP process, others can be reduced by making changes to the policy design. These changes can involve applying the experience that already exists in planning cultures with long MSP experiences, and using this experience to develop guidance documents on how to perform MSP and ways to understand central concepts. This could lessen the challenges some planning teams face thus making capacity and resources available to focus on other challenges, which ultimately would improve the depth and scope of the plan.

4. Conclusion

As indicated by previous research on policy implementation and theories of policy ambiguity (e.g. Ref. [10,21,29]), the ambiguity of MSP policy designs enhances the influence of planning cultures and makes for vastly different policy designs. Among the three planning teams studied for this paper, one of the most influential factors on the planning cultures is the professional identity of the planning authority, be it environmental (Norwegian team), economic (Danish team) or general planning (German team). The paper identified a general lack of definitions and guidance on how to understand and plan for sustainability concepts in all three policy designs. However, the German policy design does include some guidance, and this was evident in the German planner's perception of sustainability concepts. Including a definition of sustainability and what sustainable MSP entails in national policy designs for MSP could thus prove useful to planners and heighten the understanding of sustainability concepts and how to achieve sustainability objectives. For EU member states, this process would be supported if the MSPD was updated with more specific definitions of the sustainability concepts it contains as well as how to incorporate an EBA and how to plan for sustainable development. This could for instance be implemented through official guidance documents, as in the case of the Water Framework Directive.[5] The understanding of sustainability among the three planning teams largely mirrors the use and elaboration of sustainability concepts in national policy designs. Through discussion with the planning team and the support of national guiding documents, the German planning team had the most elaborate and reflective understanding of sustainability. This mirrors the German policy design, which contained the largest number and diversity of sustainability concepts of the three. The Danish and Norwegian policy design includes only a handful of sustainability concepts, which is again mirrored by an absence of understanding and reflections of sustainability concepts. Both the German and Norwegian planning teams have debated how to understand sustainability, in order to increase their understanding of this concept. Together with the lack of understanding in the Danish MSP team, this indicates a need to have more clarity of this ambiguous concept and guidance on how to implement it. If clarity and guidance on how to implement sustainability is not provided through national policy designs, this task is left to the individual planning teams, as is the case now. The Danish and German planners have been working on generating an understanding of the concept of ecosystem-based approach, which they have discussed with colleagues in order to figure out, what the concept represents. While the process of discussing and negotiating the meaning of sustainability with colleagues and stakeholders can be beneficial for the MSP process and outcome, initially having some, conceptual, clarity could create a better foundation for these debates. When planning for sustainability, impact assessments were mentioned as a valuable tool for ensuring sustainability, however, the planners face various problems in this regard. Challenges of assessing cumulative impacts, lacking data, and choosing a relevant scenario to do impact assessments on, influence the processes of impact assessments (strategic, cumulative and sectoral). Some of these challenges, such as choosing a relevant scenario, enhances the risk of not taking a precautionary approach. This can be the case if, for instance, the scenario with the lowest expected level of development is chosen for a SEA, but it turns out, with time, that a larger part of the appointed areas is being utilised, the environmental (cumulative) impacts will be unknown. With an increasing level of activities at sea, this enhances the risk of maritime activities leading to severe environmental and ecological (thus also economic and social) consequences, which is exactly the outcome MSP is meant to avoid. While this study limits its focus to the process of policy formulation and policy designs, the process of implementing marine spatial plans has not been studied, hence the result and final influence of MSP ambiguity and discussed challenges requires further investigation. One assumption could be that ambiguities in MSP policy designs trickle down into the implementation of marine spatial plans, where ambiguity might be utilised for economic purposes with the risk of unanticipated negative ecosystem impacts (as indicated by other research e.g. Ref. [7, 21]). The influence of ambiguities in policy designs on the final implementation of a marine spatial plan could therefore be a pertinent topic for future research. Only by observing the entire process of policy implementation can we evaluate the final effect of MSP ambiguities and understandings of sustainability on the outcome of the plans and the extent to which they will end up facilitating sustainable development at sea.

Credit author statement

Trine S Kirkfeldt: Conceptualization, Methodology, Formal analysis, Investigation, Writing – Original draft, Writing – Review and Editing, Visualisation, Project administration. **Jan van Tatenhove:** Conceptualization, Writing – Review and Editing, Supervision. **Helle Nedergaard Nielsen:** Methodology, Writing – Review and Editing, Supervision. **Sanne Vammen Larsen:** Methodology, Writing – Original Draft, Supervision.

Declarations of competing interest

The authors have no competing interests to declare.

[5] https://ec.europa.eu/environment/water/water-framework/facts_figures/guidance_docs_en.htm.

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Appendix A

Legal frameworks for marine spatial planning

	Documents	English translation
Danish legislation	Lov om Maritim Fysisk Planlægning (LOV nr 615 af 08/06/2016)	Law on maritime spatial planning
Norwegian legislation	Lov om petroleumsvirksomhet (petroleumsloven)	Law on petroleum
	Lov om vern mot forurensninger og om avfall (forurensningsloven)	Law on protection against pollution and waste
	Lov om fornybar energiproduksjon til havs (havenergilova)	Law on renewable energy resources at sea
	Lov om forvaltning av naturens mangfold (naturmangfoldloven)	Law on management of natural diversity
	Lov om forvaltning av viltlevande marine ressursar (havressurslova)	Law on management of living marine resources
	Lov om førstehandsomsetning av viltlevande marine ressursar (fiskesalslagslova)	Law on first-hand sales of wildlife marine resources
	Lov om mineralvirksomhet på kontinentalsokkelen (havbunnsmineralloven)	Law on mineral activities on the continental shelf
German legislation	Raumordnungsgesetz	Regional Planning Act
	Niedersächsisches Raumordnungsgesetz	Lower Saxony Regional Planning Act
	Gesetz über die Raumordnung und Landesplanung des Landes Mecklenburg-Vorpommern – Landesplanungsgesetz (LPlG)	Law on spatial planning and state planning of the State of Mecklenburg-Western Pomerania - State Planning Act
	Gesetz- und Verordnungsblatt für Schleswig-Holstein	Law and regulation for Schleswig-Holstein
	Concepts and Strategies for Spatial Development in Germany	
	Decision of the 41st Standing Conference of Ministers responsible for Spatial Planning in Berlin on 09 March 2016	

Appendix B

Categories for interview coding:

- Understanding sustainability
- Ensuring sustainability
- UN Sustainable Development Goals
- Environmental impacts
- Integrated vs sectoral
- Challenges
- Planning culture
- Competences/Experience
- The directive
- Implementing the directive
- Influence of plan
- Planning approach/structure
- Purpose of plan
- Focus of plan
- Coordination between strategy and plan
- Transboundary collaboration
- Internal/national collaboration
- Stakeholders
- Attention from the public

References

[1] C. Frazão Santos, M. Orbach, H. Calado, F. Andrade, Challenges in implementing sustainable marine spatial planning: the new Portuguese legal framework case, Mar. Pol. 61 (2015) 196–206, https://doi.org/10.1016/j.marpol.2015.08.010.
[2] C. Ehler, F. Douvere, Marine spatial planning: a step-by-step approach toward ecosystem-based management, IOC manual, Intergov. Oceanogr. Comm. Man Biosph. Program (2009) 1–98 (Intergovernmental Oceanographic Commission and Man and the Biosphere Programme).
[3] C.F. Santos, Marine Spatial Planning in Portugal: an Ocean Policy Analysis, University of Lisbon, 2016, https://doi.org/10.13140/RG.2.2.27421.20963.
[4] European Commission, European MSP Platform, (n.d.). http://msp-platform.eu/.
[5] B. Friess, M. Grémaud-Colombier, Policy outlook: recent evolutions of maritime spatial planning in the European Union, Mar. Pol. (2019) 1–8, https://doi.org/10.1016/j.marpol.2019.01.017.
[6] D. Liefferink, M. Wiering, Y. Uitenboogaart, The EU Water Framework Directive: a multi-dimensional analysis of implementation and domestic impact, Land Use Pol. 28 (2011) 712–722, https://doi.org/10.1016/j.landusepol.2010.12.006.
[7] B. Hassler, N. Blažauskas, K. Gee, A. Luttmann, A. Morf, J. Piwowarczyk, F. Saunders, I. Stalmokaitė, H. Strand, J. Zaucha, New generation EU directives, sustainability, and the role of transnational coordination in Baltic Sea maritime spatial planning, Ocean Coast Manag. 169 (2019) 254–263, https://doi.org/10.1016/j.ocecoaman.2018.12.025.
[8] C. Knill, A. Lenschow, Implementing EU Environmental Policy: New Directions and Old Problems, Manchester University Press, 2000.
[9] C. Knill, A. Lenschow, Compliance, communication and competition: patterns of EU environmental policy making and their impact on policy convergence, Eur. Environ. 2 (2005) 114–128, https://doi.org/10.1002/eet.376.
[10] A. Zhelyazkova, C. Kaya, R. Schrama, Decoupling practical and legal compliance: analysis of member states' implementation of EU policy, Eur. J. Polit. Res. 55 (2016) 827–846, https://doi.org/10.1111/1475-6765.12154.
[11] A.K. Manderson, A systems based framework to examine the multi-contextural application of the sustainability concept, Environ. Dev. Sustain. 8 (2006) 85–97, https://doi.org/10.1007/s10668-005-2787-6.
[12] G. Miller, Exploring engineering and sustainability: concepts, practices, politics, and consequences, Eng. Stud. 6 (2014) 23–43, https://doi.org/10.1080/19378629.2014.902951.

[13] S. Lumley, P. Armstrong, Some of the nineteenth century origins of the sustainability concept, Environ. Dev. Sustain. 6 (2004) 367–378, https://doi.org/10.1023/B:ENVI.0000029901.02470.a7.
[14] J. Cairns Jr., Will the real sustainability concept please stand up? Ethics Sci. Environ. Polit. (2004) 49–52.
[15] J.P.M. van Tatenhove, Transboundary marine spatial planning: a reflexive marine governance experiment? J. Environ. Pol. Plann. (2017) https://doi.org/10.1080/1523908X.2017.1292120.
[16] K. Sapountzaki, H. Karka, The element of sustainability in the Greek statutory spatial planning system: a real operational concept or a political declaration? Eur. Plann. Stud. 9 (2001) 407–426, https://doi.org/10.1080/09654310120037649.
[17] C.F. Santos, T. Domingos, M.A. Ferreira, M. Orbach, F. Andrade, How sustainable is sustainable marine spatial planning? Part I-Linking the concepts, Mar. Pol. 49 (2014) 59–65, https://doi.org/10.1016/j.marpol.2014.04.004.
[18] S. Winter, The SAGE handbook of public administration, in: G. Peters, J. Pierre (Eds.), SAGE Handb. Public Adm., SAGE Publications Ltd, London, 2012, pp. 255–264, https://doi.org/10.4135/9781446200506.
[19] S. Winter, V.L. Nielsen, Implementering Af Politik, Academica, 2008. https://hansreitzel.dk/products/implementering-af-politik-bog-19098-9788776755904. (Accessed 3 May 2019).
[20] V.E. Baier, J.G. March, H. Saetren, Implementation and ambiguity, Scand. J. Manag. Stud. (1986) 197–212.
[21] R.E. Matland, Synthesizing the implementation literature: the ambiguity-conflict model of policy implementation, J. Publ. Adm. Res. Theor. 2 (1995) 145–174, https://doi.org/10.1093/oxfordjournals.jpart.a037242.
[22] P.J. May, Policy design and implementation, in: G. Peters, J. Pierre (Eds.), SAGE Handb. Public Adm., SAGE Publications Ltd, London, 2012, pp. 279–291, https://doi.org/10.4135/9781446200506.n18 Print.
[23] J. Knieling, F. Othengrafen, Planning culture—a concept to explain the evolution of planning policies and processes in Europe? Eur. Plann. Stud. 23 (2015) 2133–2147, https://doi.org/10.1080/09654313.2015.1018404.
[24] F. Othengrafen, M. Reimer, The embeddedness of planning in cultural contexts: theoretical foundations for the analysis of dynamic planning cultures, Environ. Plann. A 45 (2013) 1269–1284, https://doi.org/10.1068/a45131.
[25] K. Li, P. Dethier, A. Eika, D.A.A. Samsura, E. van der Krabben, B. Nordahl, J. M. Halleux, Measuring and comparing planning cultures: risk, trust and co-operative attitudes in experimental games, Eur. Plann. Stud. (2019) 1–21, https://doi.org/10.1080/09654313.2019.1612325, 0.
[26] D. Stead, J. de Vries, T. Tasan-Kok, Planning cultures and histories: influences on the evolution of planning systems and spatial development patterns, Eur. Plann. Stud. 23 (2015) 2127–2132, https://doi.org/10.1080/09654313.2015.1016402.
[27] A. Faludi, The Netherlands: a culture with a soft spot for planning, Comp. Plan. Cult. (2012) 285–308, https://doi.org/10.4324/9780203826508.
[28] F. Othengrafen, Spatial planning as expression of culturised planning practices: the examples of Helsinki, Finland and Athens, Greece, Town Plann. Rev. 81 (2010) 83–110, https://doi.org/10.3828/tpr.2009.25.
[29] O. Treib, Implementing and complying with EU governance outputs, Living Rev. Eur. Govern. 9 (2014), https://doi.org/10.12942/lreg-2014-1.
[30] B. Sanyal, Comparative Planning Cultures, Taylor and Francis, 2012, https://doi.org/10.4324/9780203826508.
[31] P. Gazzola, V. Onyango, Shared values for the marine environment–developing a culture of practice for marine spatial planning, J. Environ. Pol. Plann. 20 (2018) 468–481, https://doi.org/10.1080/1523908X.2018.1438253.
[32] S. Kidd, D. Shaw, Reconceptualising territoriality and spatial planning: insights from the sea, Plann. Theor. Pract. 14 (2013) 180–197, https://doi.org/10.1080/14649357.2013.784348.
[33] L.C. Wassenhoven, The Ancestry of Regional Spatial Planning: A Planner's Look at History, 2018, https://doi.org/10.1007/978-3-319-96995-4.
[34] T. Hall, Planning and Urban Growth in Nordic Countries, Taylor & Francis e-Library, London, 1991.
[35] M. Reimer, Planning cultures in transition: sustainability management and institutional change in spatial planning, Sustain. Times 5 (2013) 4653–4673, https://doi.org/10.3390/su5114653.
[36] P. Healey, A. Khakee, A. Motte, B. Needman, Making Strategic Spatial Plans: Innovation in Europe, UCL Press, 1997.
[37] European Commission, The EU compendium of spatial planning systems and policies, Eur. Plann. Stud. 3 (1997) 192, https://doi.org/10.1080/09654319508720313.
[38] G. Larsson, Spatial Planning Systems in Western Europe: an Overview, IOS Press, 2006.
[39] M. Oxley, T. Brown, V. Nadin, L. Qu, L. Tummers, A. María Fernández-Maldonado, Review of European Planning Systems, Leicester, 2009.
[40] D. Stead, Convergence, divergence, or constancy of spatial planning? Connecting theoretical concepts with empirical evidence from Europe, J. Plann. Lit. 28 (2013) 19–31, https://doi.org/10.1177/0885412212471562.
[41] B. Willem-Wicher, Discovering the Locus of European Integration - the Contribution of Planning to European Governance in the Cases of Structural Fund Programmes, Trans-European Networks, Natura 2000, and Agri-Environmental Measures, 2003.
[42] S. Jay, T. Klenke, F. Ahlhorn, H. Ritchie, European Planning Studies Early European Experience in Marine Spatial Planning: Planning the German Exclusive Economic Zone, 2012, https://doi.org/10.1080/09654313.2012.722915.
[43] B. Elling, H.N. Nielsen, The Misleading of Public Participation in Environmental Assessment – Exploring Four Infrastructure Cases in Denmark, 2018, p. 7200, https://doi.org/10.1080/1523908X.2017.1381591.
[44] European MSP Platform, Maritime Spatial Planning, Country Information, Germany, 2018.
[45] S. Jay, T. Klenke, H. Janßen, Consensus and variance in the ecosystem approach to marine spatial planning: German perspectives and multi-actor implications, Land Use Pol. 54 (2016) 129–138, https://doi.org/10.1016/j.landusepol.2016.02.015.
[46] T.S. Kirkfeldt, An ocean of concepts: why choosing between ecosystem-based management, ecosystem-based approach and ecosystem approach makes a difference, Mar. Pol. 106 (2019) 103541, https://doi.org/10.1016/j.marpol.2019.103541.

Paper 3

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Assessment of collective pressure in marine spatial planning: The current approach of EU Member States

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ABSTRACT

We report on EU Member States' assessment of the collective pressure through cumulative impact assessments (CIA) in their implementation of the EU Maritime Spatial Planning Directive (MSPD). While the MSPD is ambiguous on how to approach the assessment of collective pressures, the present study is based on a pre-understanding that CIAs are required in marine spatial planning (MSP) for two reasons. Firstly, to address all relevant human activities and their pressures in order to comply with the concept of an 'ecosystem-based approach' and to ensure a good environmental status. Secondly, indirectly, to ensure that land-sea interactions are taken into account. Our results show few and inadequate examples of CIA in national MSP processes. Most MSP processes address collective pressure through CIA as part of a strategic environmental impact assessment. In conclusion, while the MSPD requires MSP to ensure collective pressure is kept below a level compatible with good environmental status, as part of an ecosystem-based approach, the study found few examples of ecosystem-based MSP.

1. Introduction

European seas are not as clean, healthy and productive as they have been (Reker et al., 2020). In many areas, especially coastal, the overarching objectives laid down in the Marine Strategy Framework Directive (MSFD, 2008/56/EC), the Water Framework Directive (WFD, 2000/60/EC) and the Natura 2000 Directives (Habitats Directive, 2008/99/EC; Birds Directive, 2009/147/EC) have not yet been achieved (Andersen et al., 2019a, 2019b; Vaughan et al., 2019). A key reason for impaired environmental status in many areas is high levels of pressures from multiple human activities (Korpinen et al., 2019). Marine biodiversity is under siege in all European regional seas (Reker et al., 2020; EEA, 2019). The key pressures in Europe's seas are fishing, especially overfishing and bottom-trawling, inputs of nutrients, climate change, tourism and, in some areas, introduction of non-indigenous species (Vaughan et al., 2019). Eutrophication is a large-scale problem in Europe, especially in the Baltic Sea and Black Sea and in the southern and eastern parts of the North Sea (Andersen et al., 2019a). Eutrophication problem areas are also identified in some coastal waters in the North-east Atlantic Ocean and in parts of the Mediterranean Sea, especially in downstream catchments with intense agriculture and/or industry (Andersen et al., 2019a). Contaminants are also an extensive threat, with problem areas identified in the Baltic Sea, the Black Sea, the North-east Atlantic Ocean including the North Sea and in the Mediterranean Sea (Andersen et al., 2019b).

The increasing level of pressure on the marine environment from human activities has led to a growing practice of more holistic management initiatives such as marine/maritime spatial planning (MSP) (Kannen 2014; Kelly et al., 2014). In the European Union, the practice of MSP came into legislation through the Directive for MSP (MSPD) in 2014 (Directive, 2014/89/EU). This Directive requires EU Member States to have marine spatial plans in place by March 2021, which, following the Directive, should apply an "*ecosystem-based approach as referred to in Article 1(3) of Directive (2008)*/56/EC" to ensure that "*the collective pressure of all activities is kept within levels compatible with the achievement of good environmental status*" (intr. (14)). The Directive does not specify any directions for how EU Member States are to ensure that the collective pressure stays beneath this threshold. It does however suggest a close connection to the Marine Strategy Framework Directive (MSFD, Directive, *2008*/56/EC), albeit the ecosystem-based approach is not further elaborated in the MSFD. The MSFD also refrains from giving clear instructions for how to approach the 'collective pressure' element,

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although it does specify that EU Member States should conduct: "*an analysis of the predominant pressures and impacts* (…)" which "*covers the main cumulative and synergetic effects*". Thus, the MSFD sets specific requirements for an assessment of cumulative pressures and impacts.

In the two Directives, the ecosystem-based approach is mentioned, however ambiguously, as a means for reaching the objective of Good Environmental Status (GES) by keeping collective pressures down. The objective of GES is thus shared by the two Directives, but means to achieve this objective are not specified. The type of ambiguity relating to the means for achieving a policy objective is often referred to as 'policy ambiguity' (Matland, 1995). Ambiguity can be related to both policy goals and means, and has been found connected to unclear problem definitions and policy responses (Arentsen et al., 2000; Liu et al., 2018; Matland, 1995). Through his ambiguity-conflict model for policy implementation, Matland, (1995) argues that in cases of high level of policy ambiguity, the outcome could be either a symbolic implementation (if conflict levels are high) or an experimental implementation (if conflict levels are low). The outcome of the latter depends largely on contextual conditions and the actors involved in the implementation process (Matland, 1995). Ambiguous formulations are often used strategically in policy formulation processes as 'constructive ambiguity', with the purpose to facilitate the amalgamation of all signatories. Henry Kissinger defined 'constructive ambiguity' as "*the deliberate use of ambiguous language on a sensitive issue in order to advance some political purpose*" (Berridge, 2003). However, while 'constructive ambiguity' can be constructive in bringing signatories together, it has been found to lead to destructive outcomes (Mitchell, 2009; Jegen and Mérand, 2014; Dingley, 2005; Liu et al., 2018). This indicates that ambiguities in the MSPD, on how to assess and address collective pressures, can lead to either symbolic or experimental implementations, with the potential of leading to destructive outcomes.

While the MSPD does not specify how to address collective pressures, the most acknowledged and applied approach for assessing the level of collective pressure is through the practice of cumulative impact assessments, originally developed by Halpern et al. (2008) (see review by Korpinen and Andersen, 2016). Terminology varies slightly between studies and Directives (e.g. cumulative/collective/combined impacts/pressures/effects), but essentially, they refer to the same, i.e. an additive approach to map and analyse the potential effects of multiple human pressures on marine species, habitat and communities.

Cumulative impact assessment (CIA) is recognised as a crucial element of operationalising an ecosystem-based approach (Kelly et al., 2014; Andersen et al., 2015; Langlet and Westholm, 2019) and is therefore seen as a key element of MSP (Stock and Micheli, 2016; Menegon et al., 2018). It is also considered an ideal tool for the allocation of conservation initiatives (Ban et al., 2010; Fernandes et al., 2018). Furthermore, CIA is considered a crucial practice in the formulation and achievement of sustainability objectives (Kelly et al., 2014; Willsteed et al., 2018; Furlan et al., 2019). One way in which CIA can benefit MSP is by identifying which activities can or cannot be placed in the same area, and by locating areas where human pressures result in poor environmental status (Halpern et al., 2008). The latter is key in fulfilling its purpose in MSP within the MSPD framework.

Besides the requirements of the MSPD to address collective pressures as part of the MSP practice, Member States are bound by the EU Directive for Strategic Environmental Impact Assessments (Directive, 2001/42/EC) to assess cumulative impacts. The Directive states that for plans, such as marine spatial plans, a strategic environmental impact assessment (SEA) should be performed, in which: "(…) *the likely significant effects on the environment of implementing the plan* (…) *are identified, described and evaluated*", including cumulative impacts. However, previous research has found limited proof of actual assessment of cumulative impacts in SEAs (Cooper and Sheate, 2002, 2004; Duinker et al., 2013; Kirkfeldt et al., 2017). These findings do not support an assumption that cumulative impacts of marine spatial plans are addressed adequately in SEAs. Rather, previous research supports an assumption that distinct and thorough CIAs are lacking in MSP.

This article examines the current practice of CIA in EU MSP, in order to find similarities and differences, challenges and successes, and finally, in order to assess the extent to which MSP in EU marine waters can be seen as ecosystem-based MSP, and to reflect on the influence of 'policy ambiguity'.

2. Methodology

The empirical basis for this desk study at hand comprises a questionnaire and a desk study of previous and ongoing practices of CIA in EU Member States in relation to MSP. 22 Member States have maritime territories and thus need to comply with the MSPD. The desk study involved a systematic search, for each of the 22 Member States plus the UK (as data collection took place prior to Brexit), for information on potential CIA practices. Primary sources were: 1) marine spatial plans (draft and approved plans), 2) impact assessments, 3) national and project-based websites on MSP practices, as well as 4) the EU MSP platform (European MSP Platform, 2020). This led to an overview of current (and prior) CIA initiatives.

Findings from this study were supplemented with a questionnaire, which was sent out to national MSP authorities (located through the European MSP Platform) in all 23 countries. The purpose of the questionnaire was to collect additional information on national practices as well as to validate the results of the desk study. Questions focused on CIA methodology, the role of CIA in MSP as well as personal perspectives and experiences. The questionnaire lead to 35 answers, with at least one answer from each country. Most respondents were planners or GIS experts from the MSP unit or (in three cases) a researcher who has been involved in the MSP process. The list of questions can be found in Appendix S1 in Supplementary Data.

3. Results

3.1. Current practice of CIA in the EU MSP

The desk study of present or previous CIA initiatives for MSP in EU found cases of CIA. Some were presented in SEAs, however most evidence of CIA was found within projects and tool developments. These include SYMPHONY, SIMWESMED and SIMNORAT as well as the ADRIPLAN Cumulative impact tool (for a comprehensive overview of MSP related EU projects confer with Friess and Grémaud-Colombier, 2019). The findings from the desk study are presented in its entirety in Appendix S2 (in Supplementary Data). SYMPHONY is a model-based tool that was developed to assist an ecosystem-based approach in the Swedish MSP process (SwAM, 2019; Hammer et al., 2020). The cumulative impact is calculated following the methodology as presented by Halpern et al. (2008) and mapped, illustrating how the impacts on ecosystem components in relation to the intensities of varioushuman pressures are spatially distributed (SwAM, 2019). For each cell of 250 × 250 m, the impact is calculated as the sum of an average of all pressures multiplied by a sensitivity factor for each ecosystem component (European MSP Platform, no date). It can be used to assess and illustrate cumulative impacts of various planning scenarios (SwAM, 2019). SIMWESMED and SIMNORAT were two projects that ran from 2017 to 2019 with the purpose to assist the implementation of MSP in the Western Mediterranean and North Atlantic Region, respectively (European MSP Platform, 2020). These projects completed a review of existing tools and methodologies for cumulative impact assessments (Gimard et al., 2019) and initiated further development through project-based CIAs, e.g. by combining CIA methodology with the decision support tool DESEASION (Loyer and Carval, 2019). The ADRIPLAN cumulative impact tool was developed through the ADRIPLAN project that ran from 2013 to 2015 with the purpose to facilitate MSP in the Adriatic-Ionian region (European MSP Platform, 2020). The methodology of the tool is primarily based on the framework presented in Andersen et al. (2013)

which builds upon Halpern et al. (2007) but was as well further developed e.g. by suggesting a three-level methodology for how to perform and integrate a sensitivity analysis in a CIA (Gissi et al., 2017). While these projects and tools are examples where CIA has been practiced in relation to MSP processes, the total list of located CIA initiatives was short, and with the exception of SYMPHONY, there were no examples of CIAs performed as part of the MSP for the entire MSP area.

The reason for the inadequate list of CIA initiatives can partly be explained by the stage at which some countries are in their MSP process. In the questionnaire, 20 respondents stated that a CIA had been performed or was in the making, while six respondents answered that it will be performed, thus it has not yet been performed (Fig. 1). For the one respondent who answered no, another respondent from the same MSP area answered yes. The 'no' could therefore indicate different understandings of what constitute a CIA. Three respondents answered 'Don't know', which could indicate that the respective planning teams have not yet discussed the issue of CIA, or that the task of performing an SEA is outsourced with limited correspondence and therefore somewhat less transparent to the respondents. SEAs are often, but not always, outsourced to another agency or an external consultancy, thus the knowledge on the SEA process within the MSP unit depends on the level of communication between the two units. The 'Other' response clarifies that CIA has been performed but only for parts of the MSP area.

The findings from the questionnaire support the findings in the desk study in terms of the extent of distinct CIAs versus assessment of cumulative impacts as part of a SEA. 15 out of 18 respondents answered that a CIA was conducted as part of a SEA or another impact assessment. This indicates that the practice of CIA in MSP processes primarily depends on SEA legislation and that requirements for CIA is scarce if at all existing in national MSP legislation.

Of the 20 respondents who stated a CIA has been performed or is in the making, only 11 respondents could provide information on methodological details such as the number of ecosystem elements included in the assessment (of which six stated 'Above 25' cf. Fig. 2). The same picture was seen when respondents were asked how many pressures the CIA included, for which four respondents answered 'above 25', one answered between 21 and 25, two answered between 15 and 10 and three answered 'below 10'. The numbers of ecosystem components and pressures clearly show a varied picture of CIAs.

When asked whether sensitivity weights were used, only two respondents, from two different countries, answered 'Yes' (while six answered 'No' and five answered 'Don't know'), which indicates a limited use of sensitivity weights in CIAs for MSP. While the limited number of answers on CIA methodology might be an indication of outsourcing, it can also indicate that assessments of cumulative impacts are sometimes addressed qualitatively, without any model or use of quantitative indicators, and thus no use of sensitivity weights.

3.2. Applied models and software

When asked what methodology was used for the CIA, seven respondents gave concrete answers on applied methodologies; the one developed by Halpern et al. (2008), expert knowledge, Framework for the Assessment of Ecological and Cumulative Effects (Noordzeeloket, no date), multi-criteria analysis, PlanWise4Blue (PlanWise4Blue, no date), and the one presented by Kotta (2017). Of the six methodologies, three are known to involve modelling.

When asked about applied software, eight respondents said no software was used for the assessment of cumulative impacts, while five answered 'Don't know'. Four respondents listed their applied software; two said spatial data analysis (ArcGIS) and two said SYMPHONY. The low number of applied models and software indicates that most CIAs are done as qualitative assessments without the application of a specific model.

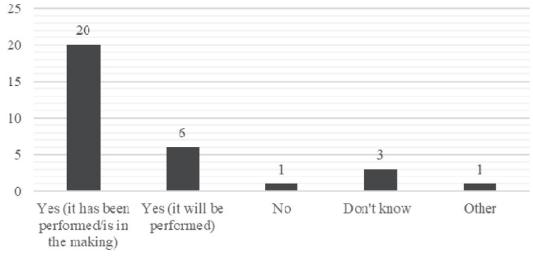

Fig. 1. Answers to 'Is a cumulative impact assessment performed at any stage of the MSP process?'

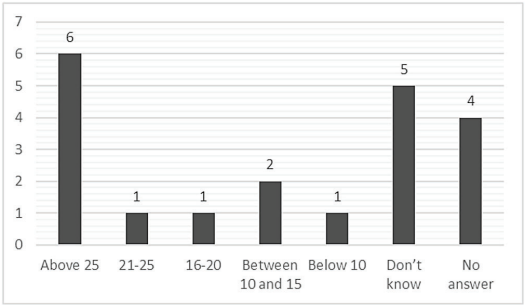

Fig. 2. *Answers to 'How many ecosystem elements are included (e.g. species, habitats etc.)?'*

3.3. The role of CIA in ensuring good environmental status

While the purpose of assessing cumulative impacts in MSP is to ensure that the level of collective pressure of human activities is compatible with ensuring a good environmental status (GES), there was some disagreement among the respondents as to the exact role of CIAs (Fig. 3). Most respondents stated however that CIAs 'To some extent' ensure good environmental status.

One respondent emphasised that the role of CIA in MSP is not to ensure GES, while MSP in itself can only influence a few of the GES descriptors (EC 2019), and that MSP can only ensure that the practice of MSP in itself does not worsen the state of the environment. Most respondents saw CIA as a crucial step in ensuring GES but clarified that whether it facilitates GES depends on how the results are used. One statement exemplifies this view: "*The assessment of cumulative impacts alone will not ensure good environmental status (…). The planning or licensing authority and/or developer has to act on the outcomes and any recommendations within the assessment.*". This respondent sees the role of

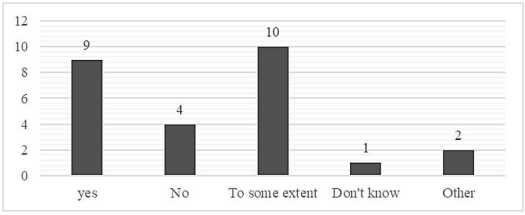

Fig. 3. Answers to 'Does the assessment of cumulative impacts ensure a good environmental status?'

Table 1
Statements from respondents on the role of CIA in ensuring GES.

Cumulative impact assessments …:
'… is one among various tools necessary to ensure a holistic management approach for then achieving a GES'
'… contributes towards considering the interactions of many factors by which Good Environmental Status is determined but cannot, by itself, ensure that it happens.'
'… helps ensure that the cumulative effect on the wider environment of the marine area and other relevant receptors is effectively managed.'
'… are the basis for ensuring considerations in decision making including the adoption of marine spatial plans. Therefore, they may play an important role in ensuring GES.'
'… identify the "hot spots" where there are more pressures, and to address measures in those areas.'
'… can contribute to insight on effects and mitigate them.'
'… envisages possible impact and ensures that all possible mitigation measures were considered and the most appropriate for the environment planning solutions were chosen.'
'… mandatory to understand how to achieve good environmental status - however difficult to assess and does not prejudge on how policies and MSP will be elaborated and implemented.'
'… forms the basis for the monitoring of the good environmental status, and by it for the possibility of keeping or achieving this status.'

key actors in the MSP as essential for whether CIA facilitates GES. Other statements on the role of CIA are summarised in Table 1.

While the initial picture was a divided group of respondents, the qualitative answers showed the complexity in defining the role of CIA in ensuring GES. This complexity could stem from the policy ambiguity concerning the GES concept and the CIA practice found in the MSPD. The general perception of the respondents was that performing a CIA does not alone ensure GES, however, it is seen as a crucial element if GES is to be reached.

3.4. Challenges when assessing cumulative impacts

The lack of software and models applications can potentially be a result of challenges related to the practice of CIA. When asked about experienced challenges, respondents gave examples of which most can be seen as either data-related or analysis-related. Data-related challenges included a general lack of data, storage of data, visualising data uncertainty and quality assurance (sometimes compromised because of security issues). Analysis-related challenges included difficulties in identifying synergistic effects, in developing sensitivity scores, in evaluating how pressures affect species and in dealing with uncertainties as well as a general lack of knowledge of some effects. These challenges could explain the low number of modelled, quantitative CIA cases found, and that only two respondents reported an application of sensitivity scores.

Another challenge mentioned by some of the respondents was the different approaches to MSP and therefore to the assessment of cumulative impacts, caused by the ambiguous formulations of the MSPD. The openness and ambiguity of the Directive leads to different MSP approaches not only between countries but also, to the frustration of some of the respondents, within countries (where the task of MSP is shared by multiple institutions). The latter is exemplified by the statement of one respondent: "*This has implications for cross-border and transboundary marine planning within a single state as well as between the component parts of that state and neighbouring countries.*". Issues related to transboundary and cross-border practices between different juridical and institutional systems have so far primarily been found in terrestrial planning such as water management practices (Kidd and Shaw, 2007, 2013). Now, a similar level of institutional complexity is increasing within MSP. Part of the solution has been suggested to be for MSP to draw on experience from terrestrial planning as well as to increase the level of horizontal integration (Ritchie et al., 2020; Jay et al., 2016).

The implications referred to by the respondent are destructive outcomes of the (constructive) policy ambiguity of the Directive. Another respondent indicated how the ambiguity of the MSPD has trickled down into national legislation and finds that: "*the legislation that regulates MSP is quite loose*". This indicates a high risk for either experimental implementation or symbolic implementation (as defined by Matland, 1995), potentially leaving MSP to nothing more than a mapping exercise. Matland (1995) suggests that the level of policy ambiguity should be reduced: "*through explicit goals or a crystallization of discussion around a limited number of possible means*", in order to improve the policy outcome. Following this suggestion, the heterogeneity of MSP practices and the institutional complexity among and within MSP states could e.g. be reduced if guidelines related to the implementation of the MSPD were formulated by the European Commission. These guidelines could provide a framework for ideal implementation of the ecosystem-based approach including how to ensure that the collective pressure is kept at a level compatible with GES.

One way of reducing the challenges mentioned by the respondents could be to increase the collaboration between CIA processes related to national (and/or regional) MSP processes and national marine strategy processes (the implementation of the MSFD). The questionnaire however revealed that collaboration is already taking place. 18 out of 26 respondents said there has been cooperation between the two agencies responsible for the marine spatial plan and the marine strategy. Three respondents (from three different countries) stated however, that the two tasks are carried out by the same agency. The responses revealed that cooperation was mostly carried out on a strategical level and rarely on a technical and analytical aspect such as CIA. When asked whether the cooperation concerned the assessment of cumulative impact, only five answered 'yes', and one respondent emphasised that there could be more cooperation. This indicates a potential for better and further collaboration between the MSP and the marine strategy unit (ideally being the same unit) on the CIA practice, which could increase CIA competences and resources.

4. Discussion and conclusions

Main lessons from this short communication include: 1) CIA practices in European MSP processes are so far scarce and primarily carried out as part of the SEA, which is usually performed in one of the final stages of an MSP process, 2) there are few examples of extensive, modelled CIAs that cover the entire MSP area, and 3) there is a need for further development of data and methodologies as well as enhanced collaboration between MSP and strategy units.

The types of CIAs practised in the studied MSP cases can be categorised as either quantitative (model-based) or qualitative (based on qualitative data). While reasons for choosing the latter approach can be numerous (as mentioned above) and justified, it is important to be aware of the strengths and, more importantly, the weaknesses of the two approaches. The qualitative approach offers a way to assess cumulative impacts in cases where data is substantially scarce. It also draws on expert/stakeholder knowledge, which can sometimes deliver information on intricate effects from multiple pressures on ecosystem components, for example in terms of synergistic and antagonistic cumulative impacts and is in general found to be of great value in MSP processes (Morf et al., 2019; Käyhkö et al., 2019).

However, the main disadvantage of qualitative CIAs is the absence of the spatial dimension and limited spatial coverage. Qualitative CIAs often lack a spatial assessment of impacts. Indeed, this is one of the advantages of model-based CIAs. Quantitative, model-based, CIAs assess cumulative impacts in each cell (of a certain size) of a marine space. For MSP, this is the ideal approach, as it allows planners to take spatial planning decisions based on existing pressures in a particular area. Quantitative CIAs are therefore better suited for MSP than qualitative, though there is still room for improvement in terms of advancing the current practice from a summation practice (adding impacts together) to incorporating knowledge on synergistic and antagonistic impacts as well as improving the coverage and comparability of data. Indeed, the transformation of expert knowledge into spatial data may be a good solution to cases where a model-based CIA is disregarded due to data

gaps. Expert knowledge can be transformed into spatial data through participatory mapping, data interpretation and geo-computing as suggested by Tolvanen et al. (2019). Examples from France and the UK have already shown how fishing activities can be spatially mapped through a collection of knowledge from fishermen (Trouillet et al., 2019; Enever et al., 2017).

The diversity of how the collective pressure is addressed by Member States exemplifies what Matland (1995) categorised as 'Experimental implementation', which largely depends on the actors involved in the implementation process and the context surrounding these actors. While diversity in practices does not in itself result in destructive outcomes, statements from the respondents indicate that differences in MSP approaches, caused by ambiguities and the openness of the MSPD, both on a national and international scale complicates the MSP process, including the practice of addressing collective pressures.

The findings from the questionnaire and desk study (in terms of the extent and methodology of existing CIAs for MSP) shows an incomplete coverage of CIAs. Of the 20 respondents who state "*a CIA has been (or is being) performed*", the level of provided information is limited, which might indicate a disconnection between the MSP team and the CIA process. It could also be a reflection of inadequate CIAs. The performance of quantitative, model-based, CIAs is very limited in EU MSP processes as most respondents assess cumulative impacts through the SEA process using qualitative, expert knowledge. This leaves a risk that severe cumulative impacts, unknown to the MSP team, exist, and thus it can be questioned whether MSP can be labelled 'ecosystem-based' if the level of knowledge is too low to do quantitative CIAs.

Leaving the assessment of cumulative impacts to the SEA process also means that the collective pressure of already existing activities is not assessed prior to the formulation of the plan, which would be needed in order to 'base' the MSP process on ecosystem conditions (i.e. being ecosystem-based). Within the MSP processes studied for this article, there was therefore chokingly scarce evidence of ecosystem-based MSP.

We therefore suggest the following means for improving the current practice: 1) it should be clarified in legislation (MSPD and national frameworks) that an ecosystem-based approach requires a CIA of existing impacts as a point of departure in the MSP process (thus a CIA as part of the SEA is not sufficient), 2) efforts should be given to a continuous development of data, both quantitative as well as transforming qualitative data into spatial data, which would facilitate further development of the CIA methodology and tools, and 3) a closer collaboration between the MSP Competent Authorities and MSFD Competent Authorities is encouraged in order to facilitate sharing of knowledge, competences and resources, thus improving the CIA quality and strengthening the ecosystem-based approach.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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References

Andersen, J.H., Stock, A., Heinänen, S., Mannerla, M., Vinther, M., 2013. Human Uses, Pressures and Impacts in the Eastern North Sea. Danish Centre for Environment and Energy. Report 18. Retrieved 26 May 2020. http://www.dmu.dk/Pub/TR18.pdf.

Andersen, J.H., Halpern, B.S., Korpinen, S., Murray, C., Reker, J., 2015. Baltic Sea biodiversity status vs. cumulative human pressures, Estuarine. Coastal and Shelf Science 161, 88–92. https://doi.org/10.1016/j.ecss.2015.05.002.

Andersen, J.H., Harvey, E.T., Murray, C., Prins, T., Reker, J., 2019a. Nutrient Enrichment and Eutrophication in Europe's Seas. European Environment Agency 14/2019, p. 46.

Andersen, J.H., Bork, N., Green, N., Harvey, T., Murray, C., Trier, X., Whaley, C., Reker, J., 2019b. Contaminants in Europe's Seas. European Environment Agency, p. 61.

Arentsen, M.J., Bressers, H.T., O'Toole, L.J., 2000. Institutional and policy responses to uncertainty in environmental policy: a comparison of Dutch and U.S. Styles. Pol. Stud. J. 28, 597–611. https://doi.org/10.1111/j.1541-0072.2000.tb02050.x.

Ban, N.C., Alidina, H.M., Ardron, J.A., 2010. Cumulative impact mapping: advances, relevance and limitations to marine management and conservation, using Canada's Pacific waters as a case study. Mar. Pol. 34 (5), 876–886. https://doi.org/10.1016/j.marpol.2010.01.010. Elsevier.

Berridge, G.R., 2003. A Dictionary of Diplomacy, second ed. Palgrave Macmillan, Basingstoke.

Cooper, L.M., Sheate, W.R., 2002. Cumulative effects assessment: a review of UK environmental impact statements. Environ. Impact Assess. Rev. 22, 415–439. https://doi.org/10.1016/S0195-9255(02)00010-0.

Cooper, L.M., Sheate, W.R., 2004. Integrating cumulative effects assessment into UK strategic planning: implications of the European Union SEA Directive. Impact Assess. Proj. Apprais. 22, 5–16. https://doi.org/10.3152/147154604781766067.

Dingley, J., 2005. Constructive ambiguity and the peace process in Northern Ireland. Low Intensity Confl. Law Enforc. 13 (1), 1–23. https://doi.org/10.1080/09662840500223531.

Duinker, P.N., Burbidge, E.L., Boardley, S.R., Greig, L.A., 2013. Scientific dimensions of cumulative effects assessment: toward improvements in guidance for practice. Environ. Rev. 21, 40–52. https://doi.org/10.1139/er-2012-0035.

C, European Commission, 2019. Our oceans, seas and coasts, achieve good environmental status. https://ec.europa.eu/environment/marine/good-environmental-status/index_en.htm. (Accessed 25 May 2020).

EEA, European Environment Agency, 2019. Regional seas surrounding Europe, figure. https://www.eea.europa.eu/data-and-maps/figures/regional-ses-surrounding-europe-1. (Accessed 24 September 2020).

Enever, R., Lewin, S., Reese, A., Hooper, T., 2017. Mapping fishing effort: Combining fishermen's knowledge with satellite monitoring data in English waters. Fisheries Research 189. https://doi.org/10.1016/j.fishres.2017.01.009.

European MSP Platform, 2020. European MSP platform. https://www.msp-platform.eu/. (Accessed 25 May 2020).

European MSP Platform, 2020. Symphony: a tool for ecosystem-based marine spatial planning. https://www.msp-platform.eu/practices/symphony-tool-ecosystem-based-marine-spatial-planning. (Accessed 24 September 2020).

Fernandes, M.L., Quintela, A., Alves, F.L., 2018. Identifying conservation priority areas to inform maritime spatial planning: a new approach. Sci. Total Environ. 639, 1088–1098. https://doi.org/10.1016/j.scitotenv.2018.05.147.

Friess, B., Grémaud-Colombier, M., 2019. Policy Outlook: Recent Evolutions of Maritime Spatial Planning in the European Union, Marine Policy. Elsevier Ltd, pp. 1–8. https://doi.org/10.1016/j.marpol.2019.01.017 (January).

Furlan, E., Torresan, S., Critto, A., Lovato, T., Solidoro, C., Lazzari, P., Marcomini, A., 2019. Cumulative impact index for the adriatic sea: accounting for interactions among climate and anthropogenic pressures. Sci. Total Environ. 670, 379–397. https://doi.org/10.1016/j.scitotenv.2019.03.021.

Gimard, A., Quemmerais, F., Allonc le, N., Bliard, F., Farella, G., Sarretta, A., Barbanti, A., Menegon, S., Bassan, N., Gissi, E., Manea, E., Musco, F., Murciano, C., Lloret, A., Cervera-Núñez, C., Campillos-Llanos, M., Gómez-Ballesteros, M., Carval, D., Loyer, S., Meyer, P., Reux, S., Giret, O., Moirano, C., 2019. Interactions between uses, between uses and environment, including cumulative impacts. Review of evaluation methods carried out in France, Spain and Italy - Western Mediterranean Sea (R18). https://doi.org/10.5281/ZENODO.2592357.

Gissi, E., Menegon, S., Sarretta, A., Appiotti, F., Maragno, D., Vianello, A., Depellegrin, D., Venier, C., Barbanti, A., 2017. Addressing uncertainty in modelling cumulative impacts within maritime spatial planning in the Adriatic and Ionian region. PloS One 12 (7), 1–30. https://doi.org/10.1371/journal.pone.0180501.

Halpern, B.S., Selkoe, K.A., Micheli, F., Kappel, C.V., 2007. Evaluating and ranking the vulnerability of global marine ecosystems to anthropogenic threats. Conserv. Biol. 21, 1301–1315. https://doi.org/10.1111/j.1523-1739.2007.00752.x.

Halpern, B.S., McLeod, K.L., Rosenberg, A.A., Crowder, L.B., 2008. Managing for cumulative impacts in ecosystem-based management through ocean zoning. Ocean Coast Manag. 51, 203–211. https://doi.org/10.1016/j.ocecoaman.2007.08.002.

Hammer, L., Molander, S., Pålsson, J., Schmidtbauer Crona, J., Carneiro, C., Johansson, T., Hume, D., Kågesten, G., Mattsson, D., Törnqvist, O., Zillén, L., Mattsson, M., Bergström, U., Perry, D., Caldow, C., Andersen, J.H., 2020. Cumulative impact assessment unlocks the potential of ecosystem-based marine spatial planning. Sci. Total Environ. 734, 1–14. https://doi.org/10.1016/j.scitotenv.2020.139024.

Jay, S., Alves, F.L., O'Mahony, C., Gomez, M., Rooney, A., Almodovar, M., Gee, K., de Vivero, J.L., Gonçalves, J.M., Fernandes, M., Tello, O., Twomey, S., Prado, I., Fonseca, C., Bentes, L., Henriques, G., Campos, A., 2016. Transboundary dimensions of marine spatial planning: fostering inter-jurisdictional relations and governance. Mar. Pol. 65, 85–96. https://doi.org/10.1016/j.marpol.2015.12.025. Elsevier.

Jegen, M., Mérand, F., 2014. Constructive ambiguity: comparing the EU's energy and defence policies. West European politics. Routledge 37, 182–203. https://doi.org/10.1080/01402382.2013.818325.

Kannen, A., 2014. Challenges for marine spatial planning in the context of multiple sea uses, policy arenas and actors based on experiences from the German North Sea. Reg. Environ. Change 14, 2139–2150. https://doi.org/10.1007/s10113-012-0349-7.

Käyhkö, N., Khamis, Z.A., Eilola, S., Virtanen, E., Muhammad, M.J., Viitasalo, M., Fagerholm, N., 2019. The role of place-based local knowledge in supporting integrated coastal and marine spatial planning in Zanzibar, Tanzania. Ocean Coast Manag. 177 (January), 64–75. https://doi.org/10.1016/j.ocecoaman.2019.04.016. Elsevier.

Kelly, C., Gray, L., Shucksmith, R.J., Tweddle, J.F., 2014. Investigating options on how to address cumulative impacts in marine spatial planning. Ocean Coast Manag. 102, 139–148. https://doi.org/10.1016/j.ocecoaman.2014.09.019.

Kidd, S., Shaw, D., 2007. Integrated water resource management and institutional integration: realising the potential of spatial planning in England. Geogr. J. 173 (4), 312–329. https://doi.org/10.1111/j.1475-4959.2007.00260.x.

Kidd, S., Shaw, D., 2013. Reconceptualising territoriality and spatial planning: insights from the sea. Plann. Theor. Pract. 14 (2), 180–197. https://doi.org/10.1080/14649357.2013.784348.

Kirkfeldt, T.S., Hansen, A.M., Olesen, P., Mortensen, L., Hristova, K., Welsch, A., 2017. Why cumulative impacts assessments of hydrocarbon activities in the Arctic fail to meet their purpose. Reg. Environ. Change 17, 725–737. https://doi.org/10.1007/s10113-016-1059-3.

Korpinen, S., Andersen, J.H., 2016. A global review of cumulative pressure and impact assessments in marine environments. Frontiers in Marine Science 3, 1–11. https://doi.org/10.3389/fmars.2016.00153.

Korpinen, S., Klancik, K., Peterlin, M., Nurmi, M., Laamanen, L., Zupančič, G., Murray, C., Harvey, T., 2019. Multiple Pressures and Their Combined Effects in Europe's Seas. European Topic Centre on Inland, Coastal and Marine Waters. Technical Report 4.

Kotta, J., 2017. Development of a Methodology "Implementation of the Marine Strategy Framework Directive in Maritime Spatial Planning (In Estonian). MTÜ Eesti Merebioloogia ühing. Talinn.

Langlet, D., Westholm, A., 2019. Synthesis Report on the Ecosystem Approach to Maritime Spatial Planning. Pan Baltic Scope. http://www.panbalticscope.eu/wp-content/uploads/2019/12/PBS-Synthesis-Report.pdf.

Liu, N., Tang, S.Y., Zhan, X., Lo, C.W., 2018. Political commitment, policy ambiguity, and corporate environmental practices. Pol. Stud. J. 46, 190–214. https://doi.org/10.1111/psj.12130.

Loyer, S., Carval, D., 2019. Cumulative effects assessment using DESEASION - in the Var county area. France. https://doi.org/10.5281/ZENODO.2605420. R19.

Matland, R.E., 1995. Synthesizing the Implementation Literature: The Ambiguity-Conflict Model of Policy Implementation. Journal of Public Administration Research and Theory May. https://doi.org/10.1093/oxfordjournals.jpart.a037242.

Menegon, S., Depellegrin, D., Farella, G., Sarretta, A., Venier, C., Barbanti, A., 2018. Addressing cumulative effects, maritime conflicts and ecosystem services threats through MSP-oriented geospatial webtools. Ocean Coast Manag. 163, 417–436. https://doi.org/10.1016/j.ocecoaman.2018.07.009.

Mitchell, D., 2009. Cooking the fudge: constructive ambiguity and the implementation of the northern Ireland agreement, 1998–2007. Ir. Polit. Stud. 24, 321–336. https://doi.org/10.1080/07907180903075751.

Morf, A., Moodie, J., Gee, K., Giacometti, A., Kull, M., Piwowarczyk, J., Schiele, K., Zaucha, J., Kellecioglu, I., Luttmann, A., Strand, H., 2019. Towards sustainability of marine governance: challenges and enablers for stakeholder integration in transboundary marine spatial planning in the Baltic Sea. Ocean Coast Manag. 177 (September 2018), 200–212. https://doi.org/10.1016/j.ocecoaman.2019.04.009. Elsevier.

Noordzeeloket. Framework for the assessment of ecological and cumulative effects (KEC) updated. https://www.noordzeeloket.nl/en/functions-and-use/offshore-wind-energy/ecology/offshore-wind/newsletter-wozep/wozep-newsletter-2/framework-assessment/. (Accessed 25 May 2020).

PlanWise4Blue. PlanWise4Blue. http://www.sea.ee/planwise4blue. (Accessed 25 May 2020).

Reker, J., Gelabert, E.R., Abhold, K., Korpinen, S., Murray, C., Peterlin, M., Vaughan, D., Andersen, J.H., 2020. Marine Messages II. Navigating the Course towards Clean, Healthy and Productive Seas through Implementation of an Ecosystem-Based Approach. EEA report.

Ritchie, H., Flannery, W., O'hagan, A.M., Twomey, S., O'mahony, C., 2020. Marine spatial planning, Brexit and the island of Ireland. Ir. Geogr. 52 (2), 213–233. https://doi.org/10.2014/igj.v52i2.1402.

Stock, A., Micheli, F., 2016. Effects of model assumptions and data quality on spatial cumulative human impact assessments. Global Ecol. Biogeogr. 25, 1321–1332. https://doi.org/10.1111/geb.12493.

SwAM, Swedish Agency for Marine and Water Management, 2019. Symphony – a tool for ecosystem-based marine spatial planning. https://www.havochvatten.se/en/swam/eu–international/marine-spatial-planning/symphony—a-tool-for-ecosystem-based-marine-spatial-planning.html. (Accessed 25 May 2020).

Tolvanen, H., Erkkilä-Välimäki, A., Nylén, T., 2019. From silent knowledge to spatial information – mapping blue growth scenarios for maritime spatial planning. Mar. Pol. 107 (June), 103598. https://doi.org/10.1016/j.marpol.2019.103598. Elsevier Ltd.

Trouillet, B., Bellanger-Husi, L., El Ghaziri, A., Lamberts, C., Plissonneau, E., Rollo, N., 2019. More than maps: providing an alternative for fisheries and Fishers in marine spatial planning. Ocean Coast Manag. 173 (February), 90–103. https://doi.org/10.1016/j.ocecoaman.2019.02.016. Elsevier.

Vaughan, D., Korpinen, S., Nygård, H., Andersen, J.H., Murray, C., Kallenbach, E., Jensen, J.N., Tunesi, L., 2019. Biodiversity in Europe's Seas. ETC ICM Technical Report 3.

Willsteed, E.A., Birchenough, S.N., Gill, A.B., Jude, S., 2018. Structuring cumulative effects assessments to support regional and local marine management and planning obligations. Mar. Pol. 98, 23–32. https://doi.org/10.1016/j.marpol.2018.09.006.

Paper 4

T. S. Kirkfeldt, van Tatenhove J.P.M. and Calado H. M. G. (submitted) Innovative diversity: the way forward on Ecosystem-based Marine Spatial Planning, submitted to *Coastal Management* on January 14 2021.

Innovative Diversity: the Way Forward on Ecosystem-based Marine Spatial Planning

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Abstract

Marine spatial planning (MSP) is currently practiced by almost half of the world's nations. While some countries are working on their second, third or fourth round of MSP, many are going through their first round of marine spatial planning. Thus, there are experiences to share and to reflect upon. Current practices of MSP shows a minimum of ecosystem-based approaches, which indicates a need to develop the practice further. This paper examines and compares best practices, selected by MSP experts, of how to take an ecosystem-based approach in MSP and presents a checklist of concrete actions for an ecosystem-based approach. The consulted experts consider close connections to other policies, such as the Marine Strategy Framework Directive and the Habitat Directive, as key to an efficient ecosystem-based MSP process. While most experts think there is a need for more, preferably localised and specific, guidelines, some find the existing guidelines adequate but find the knowledge of how to operationalise them inadequate. The selection of best practices is diverse and suggests many different ways to practice ecosystem-based MSP.

Keywords Ecosystem-based Approach; Marine Spatial Planning; Marine Strategy Framework Directive; Ecosystem-based Management; Marine Spatial Planning Directive

Introduction

Marine ecosystems all around the world are in demise due to pressures from human activities, such as fishing, shipping, resource extraction and climate change (Ehler and Douvere, 2009; European Environment Agency, 2019). Marine spatial planning (MSP) has been suggested as part of the solution by establishing "(…) *a more rational organization of the use of marine space and the interactions between its uses* (…)."(Ehler and Douvere, 2009). A key element of MSP is to implement ecosystem-based management (EBM) (Ehler and Douvere, 2009). In the EU Directive for MSP the concept of EBM is included through the ecosystem-based approach (EBA) concept (EU Directive 2014/89/EU). While

there has been some debate, concerning the two concepts as well as the concept of Ecosystem Approach (EA), there is a substantial overlap among the three (Kirkfeldt, 2019). The three concepts are all focused on having a holistic, systemic perspective on ecosystems rather than species, with an assessment of the state of ecosystems as a foundation for the planning of activities (in contrast to having environmental assessments late in the planning process), with the purpose to manage cumulative impacts and to ensure ecosystem health (Kirkfeldt, 2019). For this paper, EBA is applied as a representation for all three concepts.

While EBA is central to the MSP practice, signs of EBA in MSP are few, and there is currently a trend that MSP processes are more oriented towards blue growth than they are ecosystem-based. In a study of 44 marine spatial plans, 27 plans (two thirds) were not considered ecosystem-based, as defined in that publication (Trouillet, 2020). As of now, 79 nations are practising MSP. For most, it is their first MSP process while some (15 nations) already have implemented plans in place (UNESCO, 2020). Being an adaptive practice, MSP is a continuous process that requires recurrent monitoring, evaluation and updating (Ehler and Douvere, 2009). Thus, with the continuous degradation of marine ecosystems and the increasing level of maritime activities, MSP practices will continue to grow in numbers, and so will the importance of having efficient EBA practices in MSP.

As of now, the concept of EBA has been widely debated, not only in terms of what it entails conceptually but also, more importantly, how to practice EBA in MSP (Ansong et al., 2017; Arkema et al., 2006; Katsanevakis et al., 2011; Tallis et al., 2010). Within the EU Directive on MSP (MSPD, EU Directive 2014/89/EU) EBA is hardly defined, even though the Directive requires that "(…) *maritime spatial planning should apply an ecosystem-based approach* (…)". While EBA is not defined, three purposes are mentioned in the Directive; 1. To ensure "(…) *that the collective pressure of all activities is kept within levels compatible with the achievement of good environmental status* (…)", 2. To ensure "(…) *that the capacity of marine ecosystems to respond to human-induced changes is not compromised* (…), and 3. To contribute to "(…) *the sustainable use of marine goods and services by present and future generations* (…)" (EU Directive 2014/89/EU). The focus is thus on ensuring and improving the environmental status, ecosystem resilience and ecosystem health. Other documents on EBA/EA/EBM suggest similar objectives (CBD, 2004; Ehler and Douvere, 2009; HELCOM-VASSAB, 2016; McLeod et al., 2005), however, examples of EBA practices in MSP have so far been scarce, partly due to a lack of general experience, with MSP being a recent planning practice (Trouillet, 2020).

While the openness of the MSPD pertaining to EBA can be attributed to a lack of experience and knowledge of MSP, the ambiguity also functions as a political

tool that allows EU Member States to decide for themselves, what EBA means in their case and how they want to approach it. Policy ambiguity is a characteristic of policies that are likely to involve conflicts or in policies for new practices (Matland, 1995; Stone, 1997). MSP can be considered both prone to conflicts and a newly developed practice. The political scientist Henry Kissinger defined this type of policy ambiguity as 'constructive ambiguity' which is a "*deliberate use of ambiguous language in a sensitive issue in order to advance some political purpose*" (Berridge and James, 2003). The less constructive or - in worst case – destructive outcome of policy ambiguity can be symbolic policy implementation, in which, as the word indicates, there is no real effect of the policy, or as an experimental implementation, in which actors might take advantage of the ambiguity to promote own agendas (Matland, 1995).

Due to MSP being a recent practice, the high level of ambiguity concerning EBA and the outcomes of ambiguity, this paper sets out to decrease the level of ambiguity concerning the practice of EBA, by examining some of the best practices of ecosystem-based MSP in the world. This results in an overview of what makes an efficient EBA as well as a catalogue of concrete actions to take when attempting to perform an ecosystem-based MSP.

Methodology

The search for 'best practices' of ecosystem-based MSP is here based on MSP expert consultations (questionnaire questions can be found in Supplementary Materials SM0). Respondents were found through scientific and social networks (such as the MSP research network[1], the European MSP platform[2] and twitter). It lead to 29 completed surveys in which respondents gave their perspectives on 'best practices' of ecosystem-based MSP, as well as their own perception of what EBA entails. The content of the responses was coded in Nvivo in order to assess systematically which criteria the experts consider part of an ecosystem-based MSP process (see figure 1). The full list of criteria for an ecosystem-based MSP, mentioned by the experts can be seen in the Supplementary Material SM1.

The experts listed 24 different national MSP practices and eight MSP projects in which an EBA had been successfully performed (see Supplementary Material SM3 for the full list). Eight practices were mentioned by more than one respondent, and these were chosen for further assessment. The eight MSP practices were studied through a desk study and were then compared with the checklist of criteria for EBA in MSP, suggested by the experts. The findings of

[1] https://www.msprn.net/home

[2] https://www.msp-platform.eu/

each country were compared in order to locate potential similarities or differences among the 'best practices' of ecosystem-based MSP.

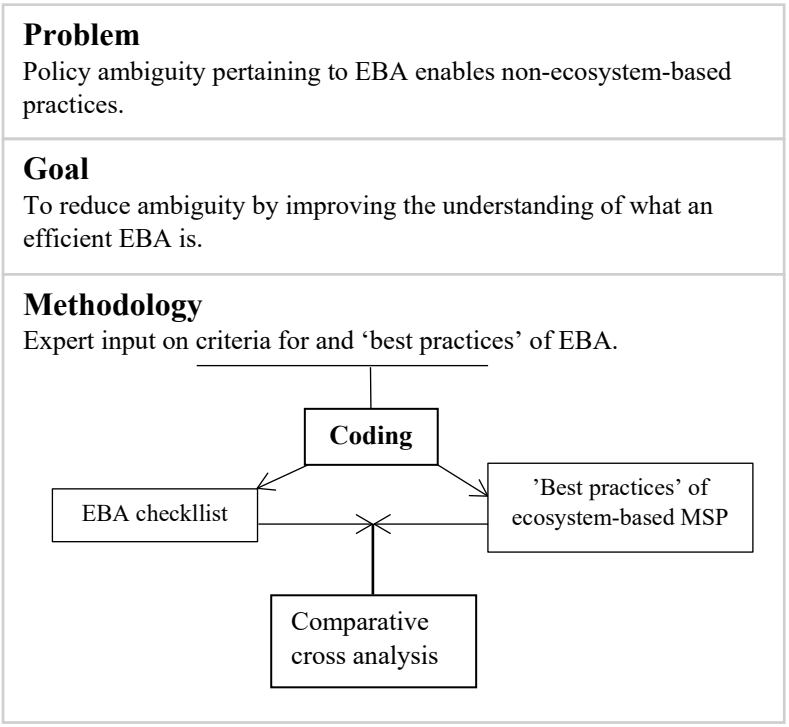

Figure 1. The methodological framework of the research presented in this paper.

Results

The 29 experts have a combined experience from 24 different countries, (see Supplementary Materials SM2). Most of them identify as researchers (15), while nine identify as planners, three identify as consultants and six as something else (e.g. analyst). Some identified with more than one category. The following two sections present a checklist of criteria for an efficient EBA and 'best practices' of ecosystem-based MSP respectively, as suggested by the experts.

Defining an efficient EBA

The list of criteria for efficient EBA practices provided by the respondents was far from unanimous and short (see table 1 for the most cited criteria and the Supplementary Materials SM1 for the full list of code categories). The checklist

consists of different criteria that relate to different stages and elements of an ecosystem-based MSP.

The criterion to have close connections to other frameworks was mentioned most frequently (9). The experts mentioned the Marine Strategy Framework Directive (directive 2008/56/EC, MSFD), the Water Framework Directive (directive 2000/60/EC, WFD), the Habitat Directive (directive 92/43/EEC, HD) and the Convention on Biological Diversity (CBD), of which the MSFD was the most emphasised. As one respondent stated: "*In the European context it* [ecosystem-based MSP] *should be integrated and in synergy with the MSFD framework".* Five respondents further emphasised how the MSP process should be linked to the MSFD through the objective for good environmental status (GES), for example to apply GES from the first planning stage of MSP. As a respondent suggested: "*Countries should firstly gather data as regards the Good Environmental Status (GES) quality of their marine, and seek to implement a plan to improve this status where necessary. Spatial planning plays a part in this, in that no activities that cause further deterioration in areas already not at GES should be allowed to take place".* This respondent sees the importance of setting GES as both a framework for data collection and as an overall objective of MSP, which was a perspective shared by many of the respondents. Another respondent suggested using MSFD indicators and descriptors in the monitoring stage of MSP.

Several of the criteria in table 1 are concerned with data/knowledge inputs to the MSP process. While some experts (5) emphasize the data driven character of MSP processes (as opposed to driven by political/stakeholder agendas), others (6) highlight the importance of stakeholder involvement early in the process "(…) *in order to collect as much useful information as possible and to get alerts when things might get wrong*", as formulated by one expert. Another respondent brought attention to the importance of closing important data gaps: "*MSP should be based on sound scientific data and efforts should be made to fill in some major knowledge gaps (where I have worked there is usually hardly any data available, even most basic data is missing.)*". Significant knowledge gaps can therefore be seen as a main barrier for a data-driven EBA.

The assessment of the environmental status and environmental impacts of activities are two other criteria that are challenged by an insufficient data foundation. Several of the criteria in table 1 relate to these practices. Two respondents mentioned the importance of a strategic environmental impact assessment (SEA). Cumulative impact assessments (CIA) and assessments of the

environmental/ecological status were both mentioned by four respondents. The performance of a CIA was seen as a guarantee "*(…) that ecosystems are fully included and that land-sea interactions also are indirectly included*", which involves another action, mentioned by two respondents, i.e. 12. Consider land-sea interactions. Again, data gaps were mentioned as a main barrier, this time pertaining to CIA. One respondent stated: "*(CIA) is a very important process to ensure that the many marine uses do not put too high pressures on the environment. However, it is very difficult to evaluate this in practice due to knowledge gaps*". Once again, this emphasises the dependency on data if an efficient ecosystem-based MSP is to be ensured.

Table 1: A check-list of criteria for an efficient EBA. Criteria that were mentioned by more than one respondent. Number of citations in ().

1. Close connection to other policies such as the MSFD (9)	**13.** Having clear objectives (2)
2. Monitoring (6)	**14.** Identify existing ecosystems, habitats and ecosystem services (2)
3. Stakeholder engagement/involvement (6)	**15.** If negative effects, look for alternatives (2)
4. Data driven (5)	**16.** Last option is mitigation and compensation (2)
5. Best available data/knowledge/technology (5)	**17.** Multi-dimensional (2)
6. Adaptive management (4)	**18.** Promote conservation and restoration activities (2)
7. Assessments of environmental/ecological status (4)	**19.** Promoting MPAs (2)
8. Building scenarios (4)	**20.** Strategical environmental assessments (2)
9. Cumulative impact assessments (4)	**21.** Use of software for modelling (2)
10. Precautionary principle (4)	
11. Climate Change considerations (3)	
12. Consider land-sea interactions (2)	

Another theme on the EBA checklist (table 1) is the uncertainty that comes with MSP. Four respondents highlighted the importance of building scenarios, in which climate change should be included (mentioned by three): "*Visioning and scenario planning is essential to make operative steps towards forward looking MSP, also considering uncertain futures and changing conditions because of - for instance - climate change effects*", as formulated by one expert. In relation to this uncertainty, four respondents also highlighted that ecosystem-based MSP applies the precautionary principle, which entails only allowing activities with negative impacts if all other options are considered, having mitigation and compensation as the very last option (mentioned by two).

The list of EBA criteria provided by the experts shows that performing an EBA is not a simple task. It should be strongly connected to the MSFD and other

relevant policy frameworks and draw on objectives and indicators within these frameworks. It also involves highly data-demanding assessments of ecological and environmental statuses, monitoring as well as impact assessments, and it involves taking a precautious approach, by building scenarios including impacts of climate change. Not least, EBA requires that any degradation of the current environmental status should be avoided, for example by having mitigation and compensation as last resort. How to integrate all of these actions and considerations in one MSP process may seem impossible but some countries have shown efficient ways of approaching this task. These are evaluated in the following.

Best practices

The consulted MSP experts predominantly mentioned national practices as examples of 'best practices' for ecosystem-based MSP, thus the focus of the following is on national practices, followed by a short summary of other examples of 'best practices'. Eight national practices were mentioned by more than one expert and were therefore further evaluated. The eight countries as well as the origin of MSP experience of the experts, who pointed to these practices, can be seen in the table below.

Table 2. The eight national practices pointed to by two or more experts and the expert's answer *to "In which country have you primarily built your knowledge/experience on MSP?".* Some experts had primary experience from more than one country. Numbers in () indicate if more than one expert have experience from this country.

'Best practice' of MSP	**Primary origin of experts' experience in MSP**
Sweden	Denmark (2), Germany, Italy, Latvia, Sweden, United Kingdom
Latvia	Bulgaria, Denmark, Germany, Latvia, United Kingdom
Shetland islands	Italy, Portugal, Scotland, United Kingdom (2)
Belgium	Belgium, Bulgaria, Portugal, Spain
Australia	Barbados, Bulgaria, Costa Rica, Greece, Italy, Mexico, Namibia, Portugal
Scotland	Ireland, Latvia, Scotland (2), United Kingdom,
The Netherlands	Cyprus, The Netherlands (2)
Palau	Barbados, Costa Rica, Greece, Italy (2), Mexico, Namibia

National Practices

While Sweden has not yet finalised their first MSP process, the Swedish practice was mentioned by the highest number of experts. Experts pointed in particular to the Swedish current status report, the use of the tool SYMPHONY and the

Green Infrastructure Approach, for why the Swedish practice is a good example of ecosystem-based MSP. Initial steps of the Swedish process involved the assessment of the current status (SwAM, 2015) and the building of a roadmap (Havs- och vattenmyndigheten, 2016). Both processes had close connections to the MSFD. A key element of the SYMPHONY tool is the assessment of cumulative impacts from the combined pressure of maritime activities, a criteria for EBA (see table 1) (Hammar et al., 2020; SwAM, 2020). Another element of the Swedish MSP process, mentioned by the experts, was the Green Infrastructure Approach, which aims at ensuring conditions for the promotion of natural values "*by introducing different types of spatial protection measures for natural values and their coherent structure*"(Translated from Swedish) (Havs- och vattenmyndigheten, 2016) (For more on the Green Infrastructure Approach see (HELCOM-VASAB, 2016)). In addition, other experts pointed to the Swedish focus on environmental protection, inclusion of climate change refugia analysis (see e.g. (Morelli et al., 2016) for more on climate refugia analysis) and their use of spatial decision support tools.

The Latvian marine spatial plan has been in place since its implementation in May 2019 (Ministry of Environmental Protection and Regional Development, 2019). The plan was developed by the Latvian Ministry of Environmental Protection and Regional development, who followed the HELCOM-VASAB guidelines for the implementation of EBA through MSP (HELCOM-VASSAB, 2016). By following these guidelines, EBA is practiced from the very beginning, ensuring an assessment of the current status of the marine environment as the first step (number 7 in table 1), in which MSFD indicators and descriptors were used as a framework for how to assess the environmental status (Veidemane et al., 2017). Furthermore, a monitoring programme was developed, and social and economic impacts of the plan were evaluated in close connection to the national implementation of the MSFD (Ministry of Environmental Protection and Regional Development, 2019). Another important element of the HELCOM-VASAB guidelines is the assessment of ecosystem services, which two of the respondents mentioned as their reason for why Latvia was considered to be among 'best practices'.

The first marine spatial plan for the Shetland Islands was in place in 2008, and the plan has since then been updated three times with the most recent one being the fourth edition (Shetland Islands Council and NAFC Marine Centre, 2015). In 2016, a new planning process for a marine regional plan was initiated, which is currently under consultation (Shetland Islands Marine Planning Partnership, 2019). The regional plan aims to contribute to the achievement of GES "(…) *particularly in relation to spatial measures. The policies in the SIRMP* [Shetland Islands Regional Marine Plan] *consider how activities can shape the marine area*

to support the goals of these Directives [WFD and MSFD], as well as those of other relevant pieces of EC legislation." (Shetland Islands Marine Planning Partnership, 2019), which indicates a close connection to other policies. The Sustainability Appraisal estimates the cumulative impact of the planned activities based on three scenarios (Shetland Isles Council and UHI and Marine Scotland, 2019), and the plan puts strong emphasis on incorporating climate change mitigation and adaptation measures, with an inherent use of the precautionary principle (Shetland Islands Council and NAFC Marine Centre, 2015).

MSP was implemented into Belgian legislation in 2012 with an amendment of the Marine Environment Act (European MSP Platform, 2020). In 2014, the first plan was adopted through the enactment of the Royal Decree to establish the marine spatial plan (FPS Public Health Food Chain Safety and Environment, 2014). In 2017, a revision of the first plan was initiated. The second marine spatial plan (2020-2026) came into force in March 2020. The process involved stakeholders both informally and formally, and an SEA was carried out as according to EU legislation. One of the basic principles in the new plan is the establishment of thresholds, which involves a continuous updating of data on, and monitoring of, the environmental and ecological status as defined in the MSFD and WFD. Good environmental and ecological status are mentioned as two of the main environmental objectives of the MSP process (Royal Decree MSP 2020). With the new plan, a new MPA is created, in addition to four already existing MPAs, and one area for bird protection will be expanded (FPS Public Health Food Chain Safety and Environment, 2020).

The Great Barrier Reef Marine Park (GBRMP) was established in 1975 with the adoption of the Great Barrier Reef Marine Park Act 1975 (Australian Government, 2016). While the main objective of the GBRMP is to "(…) *provide for the long term protection and conservation of the environment, biodiversity and heritage values*" (Australian Government, 2016), the act sets a list of goals to be achieved if they are not in conflict with the main objectives. The goals are focused on sustainable use, recreational, economic, cultural and research activities (Australian Government, 2016). One of the experts pointed to the use of the DPSIR (Driver-Pressure-State-Impact-Response) framework, which is a "*causal framework for describing the interactions between society and the environment*" (European Environment Agency, 2020). It has been used in the management of the GBRMP to structure environmental assessments and with the purpose of assessing and understanding cumulative impacts (Anthony et al., 2013; GBRMPA, 2013; Great Barrier Reef Marine Park Authority, 2017).

The Netherlands has had a formal marine spatial plan in place since 2009. The National Water Plan, which contains the Marine Spatial Plan 2009–2015, was the first formal MSP. Priority was given to activities of national importance for the

Netherlands, such as sand extraction and replenishment, sustainable (wind) energy, oil and gas extraction, CO_2-storage, shipping, and military areas. In 2015, the second formal MSP (Second National Water Plan that contains the North Sea Policy 2016–2021) was published (de Vrees, 2019; Keijser et al., 2020). The Policy Document of the North Sea 2016-2021 was developed in close connection to the implementation of MSFD, the HD, the WFD and the Malta convention (Dutch Central Government, 2015). In particular, the objective of GES (as formulated in the MSFD) is a key objective of the Dutch marine plan. The Dutch plan includes an assessment framework for permit applications e.g. for wind farms or sand extractions (Dutch Central Government, 2015). In addition, permit applicants for wind farms are assessed according to the Framework for Assessing Ecological and Cumulative effects (in Dutch: Kader Ecologie en Cumulatie (KEC)), that has the objective "*to clarify how cumulative ecological effects must be charted*"(Dutch Central Government, 2015), in addition to determining which mitigation measures are needed. Climate change impacts are addressed with information from the monitoring and analysis of the marine strategy, and sought mitigated by encouraging renewable energy and CO_2-storage technologies. Land-sea interactions are considered "*insofar as this pertains to the direct physical relationship, such as the location of a port and a shipping route* (…)" and additional information is sought from neighbouring countries on how to integrate land-sea interactions into MSP (Dutch Central Government, 2015). The plan suggests and presents four MPAs in addition to the three already existing MPAs.

The objectives of the Marine Plan of Scotland 2015 were formulated in relation to the achievement of GES and the 11 descriptors of the MSFD. In addition to specific sectoral, legislative requirements for the regional planning processes, the plan also sets out basic legislative requirements, including "1) *Assessing the condition of the region.* 2) *Summarising the significant pressures and impact of human activity.* 3) *Setting economic, social, marine ecosystem and climate change objectives."* (numbers added) (Scottish Government, 2015), which address several of the key EBA criteria of figure 1 (mainly: 7, 9 and 11). To support the regional MSP processes, the planning process of the national marine plan involved the development of Scotland's Marine Atlas, which presents an assessment of the condition of the Scottish seas, as well as a summary of impacts and pressures from human uses (Scottish Government, 2011). The atlas presents climate change as one of the most threatening pressures (along with fishing), and thus the national marine plan considers actions for climate change mitigation and adaptation for each sector (Scottish Government, 2015).

The Palauan plan was established with the enactment of the Palau Marine Sanctuary Act in 2015 (Republic of Palau, 2015). With this act, the ancient,

Palauan, conservation tradition, *Bul* (a local practice in which the Council of Chiefs placed restrictions on fishing in vulnerable reef areas (IOC and UNESCO, 2020)), was applied to the entire EEZ. The act establishes one of the largest conservation areas in the world, a no-take zone covering 80% of the Palauan EEZ. The remaining area is dedicated to domestic fishing activities, i.e. landings are going to the domestic market instead of export (Republic of Palau, 2015). The plan will be fully implemented at the end of 2020 (Global Island Partnership, 2019; PEW, 2020). With the enactment of the Palau Marine Sanctuary Act, an environmental impact fee of 100$ is required from each international visitor. A portion of the environmental impact fee goes to a trust fund, which has the purpose to enable surveillance and monitoring activities and to support eco-tourism. With this initiative, tourists are providing financial support to the conservation of the nature that likely brought them to Palau (Republic of Palau, 2015).

In table 3, each of the eight countries is evaluated according to the criteria presented in table 1.

Other efficient EBA Initiatives

While the focus has so far been on national practices, the consulted experts also mentioned a list of projects that were not related to one single, national MSP process. In particular, projects of the Baltic Sea were mentioned. These include the ECOMAR[3], Pan Baltic Scope and BALANCE[4] projects. The BALANCE project ran from 2005-2007 with the purpose to develop tools for MSP, which involved the development of the "blue corridor" concept and habitat mapping (BALANCE, 2007). Pan Baltic Scope ran from 2018-2019 and was likewise focused on tool development through cross-border collaboration on topics such as EBA, cumulative impact assessment and green infrastructure concept (Pan Baltic Scope, 2018). The ECOMAR project ran from 2018-2020 and was focused on performing a cumulative impact assessment for the Danish EEZ, including the development and testing of tools (NIVA Denmark, 2018). Other projects that were mentioned by the experts include case studies in the SIMWESTMED[5] and

[3] Short for: Development and testing of a data-driven framework for ecosystem-based marine spatial planning

[4] Short for: Baltic Sea Management – Nature Conservation and Sustainable Development of the Ecosystem through Spatial Planning

[5] Short for: Supporting Implementation of Maritime Spatial Planning in the Western Mediterranean region

Table 3. The performance of the MSP practices, pointed to by MSP experts, for each EBA criteria, presented in table 1. Deep blue: yes, light blue: to some extent, white: no/lacking information. SWE: Sweden, LAT: Latvia, SHT: Shetland Islands, BEL: Belgium, AUS: Australia, SCT: Scotland, NED: The Netherlands, PAL: Palau.

	SWE	LAT	SHT	BEL	AUS	SCT	NED	PAL
1) Close connection to other policies such as the MSFD								
2) Monitoring								
3) Stakeholder engagement/involvement								
4) Data driven								
5) Best available data/knowledge/technology								
6) Adaptive management								
7) Assessments of environmental/ecological status								
8) Building scenarios								
9) Cumulative impact assessments								
10) Precautionary principle								
11) Climate Change considerations								
12) Considers land-sea interactions								
13) Having clear objectives								
14) Identify existing ecosystems, habitats and ecosystem services								
15) If negative effects, look for alternatives								
16) Last option is mitigation and compensation								
17) Multi-dimensional								
18) Promote conservation and restoration activities								
19) Promoting MPAs								
20) Strategic Environmental Assessment								
21) Use of software for modelling								

SUPREME[6] projects and the Adriplan[7] project. The Adriplan project took place in the Adriatic-Ionian region and ran from 2013-2015. It was aimed at delivering an approach for cross-border MSP and included *inter alia* the assessment of cumulative impacts for selected areas (European MSP platform, 2020). The SUPREME and SIMWESTMED projects both took place from 2017-2018 in the Eastern and Western Mediterranean Sea, respectively. Both projects aimed at supporting national implementations of the MSPD with a particular focus on cross-border collaboration. Pilot projects were as well carried out involving the assessment of cumulative impacts (Loyer and Carval, 2019; SUPREME, 2020).

In addition to the projects presented above, experts also mentioned specific analytical approaches for efficient EBA, both as part of a national MSP process or as a standalone approach. These included the Large Marine Ecosystem (LME) approach and the Biological Valuation Mapping (BVM) practice. The LME approach is aimed at operationalising ecosystem-based management through a five-moduled strategy for assessing and monitoring LMEs and for the planning of actions for healthy ecosystems (GEF LME:LEARN, 2017). BVM functions as a baseline map in which the value and distribution of ecological and biological elements are mapped. In particular, it is used to locate areas with high biological value to inform planning and management processes and to reduce the level of risk by facilitating a more precautious approach (Ehler and Douvere, 2009).

Discussion

Having gone through the suggested practices for efficient EBA, no unanimous model for EBA appears. On the contrary, none of the presented practices has approached the EBA practice in the same way. However, in this diverse picture, the differences are what makes the practices alike. In some way, they have all approached the task in an innovative manner, developing and using tools or frameworks in new ways. While Australia is seen as a frontrunner for MSP and MPAs in the establishment of the GBRMP, Sweden is praised for the development and application of the SYMPHONY tool. Latvia is complimented for its inclusion of an ecosystem service assessment, and Palau was one of the first nations in the world to make conservation a main priority. The Netherlands is recognised for its development of the KEC framework and in Scotland, it was the development of the Marine Atlas that was noticed by respondents. It is clear from the national initiatives that each country is trying to find their own way of interpreting EBA and figuring out how to implement it. It is also clear, that so far, there is no single way of doing this. However, from the checklist of EBA criteria given by the

[6] Short for: Supporting Maritime Spatial Planning in the Eastern Mediterranean
[7] Short for: Adriatic Ionian maritime spatial Planning

respondents (table 1), the presented practices seemed to be performing particularly well on promoting MPAs, assessing (cumulative) impacts, and evaluating ecosystem services. The more recent, European, practices (Sweden, Latvia, Belgium, the Shetland Islands, the Netherlands and Scotland) were in general well connected to the MSFD and WFD frameworks (the most mentioned EBA criteria), in particular through the GES objective and descriptors. What can be learned from the diverse picture of ecosystem-based MSP practices is how EBA can be practised in many ways, while the criteria in table 1 can be used as a guideline for how to practice an efficient EBA.

The presented initiatives do also have in common that they require a substantial amount of spatial data on ecosystem components and pressures from activities. It would therefore seem that a well-performed EBA requires an extensive supply of data along with a spatial (potentially modelled) analysis of this data, however "(…) *the practice requires quite a lot of data, which is generally still sparse for the marine areas*", as formulated by one respondent. In practices where data is lacking, an efficient EBA can be practiced by implementing the precautionary approach to the fullest, and focus on conservation objectives, such as the Palauan plan.

The importance of data was as well highlighted by several respondents as a main barrier for EBA practices, along with the lack of knowledge for how to practice an EBA and lack of political will. One respondent pointed to the policy ambiguity of the directive as a major barrier for creating an operational guideline for EBA: "*The flexibility among countries on how to do MSP* (…) *makes it difficult to create an ecosystem-based approach guideline.* (…) *I think the flexibility as well as the knowledge gaps will probably mean that such a guideline will not be created in the near future*". This respondent believes the outcome of said flexibility, i.e. the ambiguous formulations of the MSPD, will be destructive for the environment *"the trade-offs* [of the flexibility] *being political decisions instead of being first-and-foremost environmental concerns"*. This trade-off, in which political decisions steer the agenda instead of environmental objectives, is a common outcome of experimental implementations (as defined by Matland (1995)). According to Matland (1995), experimental implementation can take place when levels of ambiguity are high as is the case of the MSPD.

When asked if there are sufficient guidelines on how to perform EBA, the majority of the respondents replied 'No, not quite' (see figure 2) Some respondents believes EBA "*is still perceived as a theoretical concept*" and that "*the definition is quite abstract*", as two of the respondents stated, which means that "(…) *there are many guidelines, but little guidance on what the theoretical means in practice*!" as formulated by a third respondent. There was however also a substantial part of the respondents (9) who thinks the level of guidelines is

sufficient (or almost sufficient). Some emphasised that it is impossible to provide guidelines for all cases: "*MSP is complex. Even if guidelines do exist they are rarely used (…)"* and another respondent suggested "*(…) it is more likely that lack of guidelines isn't the problem but lack of political will*". One respondent thought the number of global guidelines is sufficient, but that more localised guidelines are needed: "*There are quite a few examples of guidance documents providing clarification of the approach on a conceptual level, and largely on a global scale. Far fewer examples of regional/local guidance documents can be found which may be useful in management at implementation level*". Attempting to develop one guideline for all MSP processes is likely to be inefficient as cases such as the Netherlands and Palau vary immensely. Another respondent supports the suggestion of having more operational guidelines: "*more precise guidelines are needed on how to better apply an EBA in the different steps/actions carried out in MSP*". It would seem that in general, respondents agree that the number of conceptual, overall guidelines on EBA are sufficient, but that more specific,

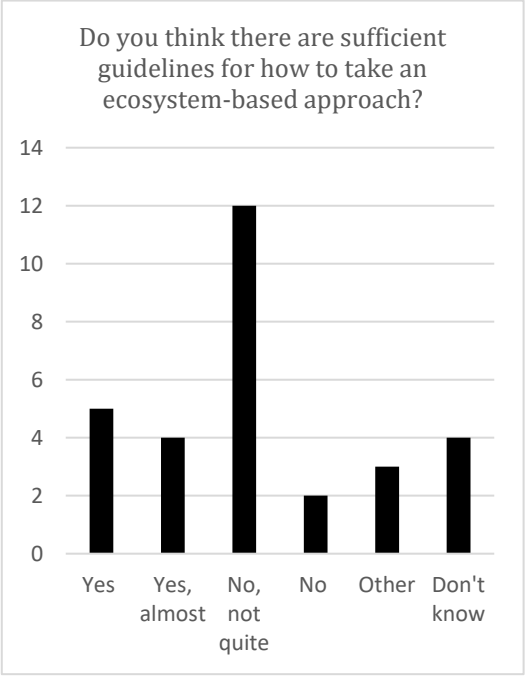

Figure 2. Answers for the question: *Do you think there are sufficient guidelines for how to take an ecosystem-based approach?*

localised and operational guidelines are needed. One respondent suggested the MSPD could be supplemented by a Common Implementation Strategy similar to the ones for the MSFD and the WFD (European Commission, 2020a, 2003). A CIS on the MSPD could provide more localised, specific and operational guidelines on EBA. The CIS process for the MSFD involved over more than 450 experts and stakeholders and has so far resulted in 15 guidance documents (available at (European Commission, 2020b)). A similar process and resulting guidance documents for the MSPD could reduce the level of policy ambiguity and thus reduce the risk of unfortunate trade-offs for the environment.

Conclusion

The assessment of criteria for efficient ecosystem-based MSP and best practices as suggested by MSP experts exemplified the ambiguous and complex nature of EBA. The list of criteria was long, and best MSP practices perform EBA in widely different ways. Experts point to the ambiguity of the MSPD as cause for the diverse practice. While this can have constructive outcomes such as innovative approaches to, and developments of, EBA, it also challenges the implementation of EBA in MSP as it remains to be perceived as a theoretical concept, challenging to operationalise. Ultimately, this results in a lack of EBA practices, as indicated by (Trouillet, 2020).

The list of criteria presented in this paper proposes a guideline for efficient EBA. In particular, experts highlight the importance of having close connections to, and applications of, other policies such as the MSFD, WFD and HD, together with an initial assessment of the environmental/ecological status through (cumulative) impact assessments, as main criteria for efficient EBA. While impact assessments requires a substantial data foundation, if data is scarce, EBA can be practiced by prioritising conservation measures and practising the precautionary principle.

Based on the findings of the paper, the authors recommend a formulation of more operational and context specific guidelines, e.g. developed through a Common Implementation Strategy. Future guidelines could e.g. address how to integrate EBA with other key actions of MSP, e.g. how to use EBA to reduce conflicts, and how to apply stakeholder information in EBA practices. Furthermore, a continued sharing of experiences and methodologies is encouraged to support a continuous development of EBA practices to aim for a future in which all MSP practices are ecosystem-based. By strengthening the current EBA practice, MSP gets closer to achieving its full potential and mission of ensuring a sustainable future for the management of the sea.

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Literature

Ansong, J., Gissi, E., Calado, H., 2017. An approach to ecosystem-based management in maritime spatial planning process. Ocean Coast. Manag. 141, 65–81. https://doi.org/10.1016/j.ocecoaman.2017.03.005

Anthony, K.R., Dambacher, J.M., Walshe, T., Beeden, R., 2013. A Framework for Understanding Cumulative Impacts, Supporting Environmental Decisions and Informing Resilience-Based Management of the Great Barrier Reef World Heritage Area.

Arkema, K.K., Abramson, S.C., Dewsbury, B.M., 2006. Marine ecosystem-based management: from characterization to implementation. Front. Ecol. Environ. 4, 525–532. https://doi.org/10.1890/1540-9295(2006)4[525:memfct]2.0.co;2

BALANCE, 2007. Welcome to BALANCE [WWW Document]. URL https://www.balance-eu.org/ (accessed 9.30.20).

Berridge, G.R., James, A., 2003. A dictionary of diplomacy, 2nd ed. Basingstoke: Palgrave Macmillan.

CBD, 2004. The Ecosystem Approach (CBD Guidelines). Secretariat of the Convention on Biological Diversity, Montreal. https://doi.org/10.1007/BF00043328

de Vrees, L., 2019. Adaptive marine spatial planning in the Netherlands sector of the North Sea. Mar. Policy. https://doi.org/10.1016/j.marpol.2019.01.007

Dutch Central Government, 2015. Policy Document on the North Sea 2016-2021 1–120. https://doi.org/10.1007/s11136-014-0818-1

Ehler, C.N., Douvere, F., 2009. Marine Spatial Planning: A Step-by-Step Approach towards Ecosystem-based Management, Intergovernmental

Oceanographic Commission. Paris.

European Commission, 2020a. Report from the commission to the European Parliament and the Council on the implementation of the Marine Strategy Framework Directive. https://doi.org/10.2771/21854

European Commission, 2020b. Guidance Documents [WWW Document]. URL https://circabc.europa.eu/faces/jsp/extension/wai/navigation/container.jsp (accessed 10.1.20).

European Commission, 2003. Common Implementation Strategy for the Water Framework Directive (2000/60/EC). Guidance document no. 11, Planning process.

European Environment Agency, 2020. DPSIR [WWW Document]. URL https://www.eea.europa.eu/help/glossary/eea-glossary/dpsir (accessed 9.23.20).

European Environment Agency, 2019. Marine messages II, Navigating the course towards clean, healthy and productive seas through implementation of an ecosystem-based approach. https://doi.org/10.2800/71245

European MSP platform, 2020. Adriplan, Adriatic Ionian maritime spatial Planning [WWW Document]. URL https://www.msp-platform.eu/projects/adriatic-ionian-maritime-spatial-planning (accessed 9.30.20).

GBRMPA, 2013. Great Barrier Reef Region Strategic Assessment, Strategic Assessment Report, Draft for public comment. Townsville.

GEF LME:LEARN, 2017. The Large Marine Ecosystem Approach: An Engine for Achieving SDG 14. Paris, Fr.

Great Barrier Reef Marine Park Authority, 2017. Cumulative Impact Management Policy, Draft for public consultation. Townsville.

Hammar, L., Molander, S., Pålsson, J., Schmidtbauer Crona, J., Carneiro, G., Johansson, T., Hume, D., Kågesten, G., Mattsson, D., Törnqvist, O., Zillén, L., Mattsson, M., Bergström, U., Perry, D., Caldow, C., Andersen, J.H., 2020. Cumulative impact assessment for ecosystem-based marine spatial planning. Sci. Total Environ. 734, 139024. https://doi.org/10.1016/j.scitotenv.2020.139024

Havs- och vattenmyndigheten, 2016. Färdplan havsplanering.

HELCOM-VASAB, 2016. Green infrastructure and MSP . Riga.

HELCOM-VASSAB, 2016. Guideline for the implementation of ecosystem-based approach in Maritime Spatial Planning (MSP) in the Baltic Sea area, 72 nd meeting of VASAB CSPD/BSR.

IOC, UNESCO, 2020. Palau [WWW Document]. URL www.msp.ioc-unesco.org/world-applications/oceania/palau/ (accessed 9.29.20).

Katsanevakis, S., Stelzenmüller, V., South, A., Sørensen, T.K., Jones, P.J.S., Kerr, S., Badalamenti, F., Anagnostou, C., Breen, P., Chust, G., D'Anna, G., Duijn, M., Filatova, T., Fiorentino, F., Hulsman, H., Johnson, K., Karageorgis, A.P., Kröncke, I., Mirto, S., Pipitone, C., Portelli, S., Qiu, W., Reiss, H., Sakellariou, D., Salomidi, M., van Hoof, L., Vassilopoulou, V., Vega Fernández, T., Vöge, S., Weber, A., Zenetos, A., Hofstede, R. ter, 2011. Ecosystem-based marine spatial management: Review of concepts, policies, tools, and critical issues. Ocean Coast. Manag. 54, 807–820. https://doi.org/10.1016/j.ocecoaman.2011.09.002

Keijser, X., Toonen, H., van Tatenhove, J., 2020. A "learning paradox" in maritime spatial planning. Marit. Stud. 19, 333–346. https://doi.org/10.1007/s40152-020-00169-z

Kirkfeldt, T.S., 2019. An ocean of concepts: Why choosing between ecosystem-based management, ecosystem-based approach and ecosystem approach makes a difference. Mar. Policy 106, 103541. https://doi.org/10.1016/j.marpol.2019.103541

Loyer, S., Carval, D., 2019. Cumulative Effects Assessment using DESEASION - In the Var County area, France (R19). https://doi.org/10.5281/ZENODO.2605420

Matland, R.E., 1995. Synthesizing the Implementation Literature: The Ambiguity-Conflict Model of Policy Implementation. J. Public Adm. Res. Theory. https://doi.org/10.1093/oxfordjournals.jpart.a037242

McLeod, K., Lubchenco, J., Palumbi, S., Rosenberg, A.A., 2005. Scientific Consensus Statement on Marine Ecosystem-Based Management. https://doi.org/10.1080/13880290109353975

Ministry of Environmental Protection and Regional Development, 2019. Maritime Spatial Plan 2030, Summary.

Morelli, T.L., Daly, C., Dobrowski, S.Z., Dulen, D.M., Ebersole, J.L., Jackson, S.T., Lundquist, J.D., Millar, C.I., Maher, S.P., Monahan, W.B., Nydick, K.R., Redmond, K.T., Sawyer, S.C., Stock, S., Beissinger, S.R., 2016. Managing climate change refugia for climate adaptation. PLoS One. https://doi.org/10.1371/journal.pone.0159909

NIVA Denmark, 2018. ECOMAR [WWW Document]. URL https://niva-denmark.com/ecomar/ (accessed 9.30.20).

Pan Baltic Scope, 2018. About us | Pan Baltic Scope [WWW Document]. URL http://www.panbalticscope.eu/about-us/ (accessed 9.30.20).

Scottish Government, 2015. Scotland's National Marine Plan [WWW Document]. URL https://www.gov.scot/publications/scotlands-national-marine-plan/ (accessed 10.1.20).

Scottish Government, 2011. Scotland's Marine Atlas: Information for The National Marine Plan - gov.scot [WWW Document]. URL https://www.gov.scot/publications/scotlands-marine-atlas-information-national-marine-plan/ (accessed 10.1.20).

Shetland Islands Council, NAFC Marine Centre, 2015. Supplementary guidance Shetland Islands' Marine Spatial Plan 202.

Shetland Isles Council and UHI and Marine Scotland, 2019. Shetland Islands Regional Marine Plan 2019 DRAFT, Sustainability Appraisal, Environment Report.

Stone, D., 1997. Policy paradox: the art of political decision making, 2. ed. W. W. Norton & Company.

SUPREME, 2020. Welcome to the Supreme Project Website [WWW Document]. URL http://www.msp-supreme.eu/ (accessed 9.30.20).

SwAM, 2020. Symphony – a tool for ecosystem-based marine spatial planning [WWW Document]. URL https://www.havochvatten.se/en/eu-and-international/marine-spatial-planning/symphony---a-tool-for-ecosystem-based-marine-spatial-planning.html

SwAM, 2015. Marine Spatial Planning, Current Status 2014, National planning in Sweden's territorial waters and exclusive economic zone (EEZ). Gothenburg.

Tallis, H., Levin, P.S., Ruckelshaus, M., Lester, S.E., McLeod, K.L., Fluharty, D.L.,

Halpern, B.S., 2010. The many faces of ecosystem-based management: Making the process work today in real places. Mar. Policy 34, 340–348. https://doi.org/10.1016/j.marpol.2009.08.003

Trouillet, B., 2020. Reinventing marine spatial planning: a critical review of initiatives worldwide. J. Environ. Policy Plan. 0, 1–19. https://doi.org/10.1080/1523908X.2020.1751605

UNESCO, 2020. Status of MSP [WWW Document]. URL http://msp.ioc-unesco.org/world-applications/status_of_msp/

Veidemane, K., Ruskule, A., Sprukta, S., 2017. Development of a maritime spatial plan: the Latvian recipe.

Supplementary Materials

For the paper: Innovative Diversity: the Way Forward on Ecosystem-based Marine Spatial Planning

Contents:

SM0. Questions of the questionnaire

In which country have you primarily built your knowledge/experience on MSP?

What is your profession?

- □ Planner
- □ Researcher
- □ Consultant
- □ Other:

What MSP process(es) or plan(s) do your perceive to be good examples of how to practice an ecosystem-based approach? - either based on your own experience or on what you have heard from others. Please be as specific as possible (location, time, title).

In your opinion, what is the best way to practice an ecosystem-based approach in MSP? E.g. which actions does it involve?

How would you in general define what taking an ecosystem-based approach means?

Do you think there are sufficient guidelines for how to take an ecosystem-based approach?

- □ Yes
- □ Yes, almost
- □ No, not quite
- □ No
- □ Other:
- □ Don't know

Why? (please elaborate your answer)

Thank you for your time and input.

Please enter your email below, if you agree that I can contact you with follow up questions, and please add any comments/reflections you might have.

SM1. Full list of respondents' definition of EBA criteria

- Actions for data gap closure
- Adaptive management
- Apply biogeographical scaling
- Apply DPSIR modelling
- Assess biodiversity impact

- Assess environmental/ecological status
- BAK.BAT.BAD
- Based on sensitivity of ecological components towards pressures
- Based on spatial-temporal analysis
- Building scenarios
- CIA
- Close connection to other politics such as the MSFD framework
- Compliance and enforcement
- Consider Climate Change
- Considers land-sea interactions
- Data driven
- Establish the gap to GES
- Exclusion of potentially significant impacts
- Flexible
- Have sus. del. for marine systems of main objectives
- Having clear objectives
- Identify areas of high nature value
- Identify existing ecosystems, habitats and ecosystem services
- If negative effects, look for alternatives
- Include cultural aspects
- Inclusion
- Last option is mitigation and compensation
- Monitoring
- Multi-dimensional
- Multi-staged
- Precautionary principle
- Promote conservation and restoration activities
- Promote sustainable use of resources
- Promoting ecological connectivity
- Promoting MPAs
- Results in zoning and regulation
- Science-based
- SEA
- Stakeholder engagement/involvement
- Trade off analysis of different scenarios
- Transparency
- Understand dependency on ecosystems and eco-services
- Use software for modelling (such as R)

SM2. Full list of countries from which respondents have MSP knowledge

- Baltic Sea
- Barbados
- Belgium
- Brazil
- Bulgaria
- Costa Rica,
- Cyprus
- Denmark (4)
- Germany
- Greece
- Indonesia
- Ireland
- Italy (4)
- Latvia
- Mediterranean countries
- Mexico,
- Myanmar
- Namibia
- Netherlands (2)
- Norway
- Portugal (3)
- Scotland (2)
- Spain (2)
- Sweden (2)
- UK (3)
- United States

SM3. Full list of best practices

Nations/regions (number of times mentioned (if more than one)):

- Australia, Great Barrier Reef Marine Park zoning plan, e.g 2014 (4)
- Azores MSP
- Baltic countries
- Barbuda, zoning plan
- Belgian MSP, e.g. 2009-2014 (4)
- Brazil, Ecological-economical Zoning, of Rio Grande do Sul State
- Cook Islands, Marae Moana ("Sacred Ocean") initiative (2017)
- Denmark MSP
- Ecuador (Galapagos)
- France MSP
- German, recent planning process
- Ireland MSP
- Kiribati (Phoenix Islands)

- Latvia MSP (5)
- Maldives MSP
- Marine planning in Palau (2)
- Norway
- Polish MSP
- Rhode Island Ocean Special Area Management Plan (Ocean SAMP) - 2014
- Scotland, the Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW) Guideline document on the subject of "Fishing Liaison Best Practice guidance for offshore renewables developers" in May 2008
- Scotland's National Marine Plan (2)
- Shetland MSP (4) e.g. the Marine Spatial Plan (SIMSP) - 2015
- Spain MSP
- Swedish MSP process (8)
- The Netherlands, e.g. policy document on the North Sea 2016-2021 (3)

Projects

- AdriPlan (northern Adriatic, involving Italy, Slovenia, Croatia, etc.)
- Adriplan. In adriatic sea - Italy
- BALANCE project - Baltic Sea - 2007-2009
- Baltic Sea EU funded projects
- Belize Marine Invest project
- Case Studies from Projects: SIMWESTMED and SUPREME (no implementation)
- ECOMAR project - Danish EEZ - 2018-2020
- Pan Baltic Scope project

Paper 5

T. S. Kirkfeldt and Santos C. F. (under review) A review of sustainability concepts in marine spatial planning and the potential to supporting the UN SDG 14, submitted to *Marine Policy* on Nov 4 2020, went into review on Nov 24 2020.

A review of sustainability concepts in marine spatial planning and the potential to supporting the UN SDG 14

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Abstract

Ecosystems all over the world are under increasing pressure from human uses. As a result, species that provide key ecosystem services are threatened by extinction. The UN Sustainable Development Goal 14 (SDG 14) seeks to ensure sustainability below water by 2020; however, the ongoing biodiversity loss and habitat deterioration caused by human activities challenge the achievement of this goal. Marine Spatial Planning (MSP) is a developing practice with a similar objective to the SDG 14, albeit research shows that most MSP cases prioritise economic objectives above environmental objectives. This paper presents an assessment of how MSP can contribute to achieving SDG 14. Results are presented in three steps. First, a representative definition of what MSP is and what it aims for is presented. Secondly, activities that can be addressed through MSP are laid out. Lastly, the results of the two first steps are used to assess how MSP can contribute to the achievement of SDG 14 targets and indicators. This assessment shows a great potential for MSP to play a role in the achievement of the SDG 14. In particular, MSP can contribute tremendously to the SDG 14 achievement by establishing Marine Protected Areas and trawling/fishing free zones. This prioritisation would presuppose a strong sustainability objective in which the health of ecosystems are prioritised above economic objectives.

Key words: SDG 14; Maritime spatial planning; Sustainable development; Ocean governance;

1 Introduction

The increasing level of interest in the marine space has put severe and diverse pressures on marine ecosystems. For this reason, the United Nations Sustainable Development Goal 14 (SDG 14), for Life Below Water, was formulated with the objective to "*Conserve and sustainably use the oceans, seas and marine resources for sustainable development*"[1]. To achieve this purpose, the UN SDG 14 addresses a variety of topics, from marine pollution to ocean acidification, conservation of marine ecosystems, or fishing regulations, among others (see Table 1). Still, the 2019 status report on progress towards the SDGs concluded that the level of protection globally is inadequate and incapable of combating the major threats of ocean acidification, overfishing and eutrophication – even if the number of marine protected areas (MPAs) is growing worldwide. Indeed, it states that "(…) *increased efforts and interventions are needed to conserve and sustainably use ocean resources at all levels*"[2] .

Table 1. The United Nations Sustainable Development Goal 14. The SDG 14 consists of ten targets, and corresponding indicators, pertaining to the sustainable use and conservation of marine resources. These include topics such as marine pollution, ocean acidification, fishing regulations, international law, or scientific knowledge [17].

TARGETS	INDICATORS
14.1 By 2025, prevent and significantly reduce **marine pollution** of all kinds, in particular from land-based activities, including marine debris and nutrient pollution	**14.1.1** Index of coastal eutrophication and floating plastic debris density
14.2 By 2020, sustainably manage and **protect marine and coastal ecosystems** to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	**14.2.1** Proportion of national exclusive economic zones managed using ecosystem-based approaches
14.3 Minimize and address the **impacts of ocean acidification**, including through enhanced scientific cooperation at all levels	**14.3.1** Average marine acidity (pH) measured at agreed suite of representative sampling stations
14.4 By 2020, effectively **regulate harvesting** and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics	**14.4.1** Proportion of fish stocks within biologically sustainable levels

14.5 By 2020, **conserve at least 10 per cent** of coastal and marine areas, consistent with national and international law and based on the best available scientific information	**14.5.1** Coverage of protected areas in relation to marine areas
14.6 By 2020, **prohibit certain forms of fisheries subsidies** which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation	**14.6.1** Progress by countries in the degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing
14.7 By 2030, **increase the economic benefits** to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism	**14.7.1** Sustainable fisheries as a percentage of GDP in small island developing States, least developed countries and all countries
14.a Increase **scientific knowledge**, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries	**14.a.1** Proportion of total research budget allocated to research in the field of marine technology
14.b Provide access for **small-scale artisanal fishers** to marine resources and markets	**14.b.1** Progress by countries in the degree of application of a legal/regulatory/policy/ institutional framework which recognizes and protects access rights for small-scale fisheries
14.c Enhance the conservation and sustainable use of oceans and their resources by implementing **international law** as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of The Future We Want	**14.c.1** Number of countries making progress in ratifying, accepting and implementing through legal, policy and institutional frameworks, ocean-related instruments that implement international law, as reflected in the United Nation Convention on the Law of the Sea, for the conservation and sustainable use of the oceans and their resources

One way of increasing such effort is through marine spatial planning (MSP). MSP has been globally recognized as a way to foster sustainable use of marine ecosystems and to promote ocean conservation [3]. As laid out by the European Union Directive on MSP (MSPD), Directive 2014/89/EU, the objective of MSP is to "(…) *promote the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources*" [4]. For this reason, the purposes of MSP largely mirror the one of the SDG 14. Indeed, they are both focused on sustainable development of maritime activities and economies while at the same time conserving and ensuring sustainable use of marine areas. By concept, MSP should therefore be able to contribute to the achievement of the SDG 14 [5–7].

However, research has found ambiguities regarding how MSP should balance objectives for environmental protection and economic development [8–12]. One of the main contributors to such ambiguity is the dichotomous role of MSP in ensuring both environmental and economic objectives at the same time. This ambiguity has resulted in MSP cases predominantly focused on achieving economic objectives before planning for environmental objectives [8,13]. This prioritisation supports what is also referred to as *weak sustainability*, as it relies on a fragile foundation if the health of marine ecosystems is not secured. Weak sustainability comes from an economical perception that all capitals are replaceable, i.e. all natural capital can be replaced with the right financial or societal capital [14]. In contrast, planning that ensures environmental sustainability before addressing objectives for economic activities builds a strong and sustainable foundation for marine ecosystems and depending maritime economies, thus aiming for *strong sustainability* [15,16]. Jones et al. (2016) found vast differences between MSP in theory and MSP in practice, with MSP cases focused on blue growth and economic development being much more prevalent than ecosystem-based MSP focused on a strong sustainability approach [13].

This paper aims to further explore and clarify the potential contribution of MSP in achieving SDG 14 and related targets (Table 1). While doing so, it also aims to decrease the ambiguity regarding the dual role of MSP in supporting both ecosystems protection and human development. These objectives are attained by conducting an in-depth analysis of key literature on MSP, assessing key MSP definitions and offering examples for concrete action.

2 Methods

The present study is composed of three main methodological phases, all of them based on the revision of the most cited documents (Scopus database) on both marine and maritime spatial planning. These are: (1) the development of a

representative MSP definition; (2) the analysis of the main human uses incorporated or managed in MSP initiatives; (3) the investigation of the contribution of MSP to each target of the SDG 14. Specificities on each phase are provided in the following sub-sections.

First, in order to identify the most applied MSP definitions in scientific literature, the Scopus database was used to search documents that included the terms "marine spatial planning" or "maritime spatial planning" in their title, abstract or keywords. After reviewing the 50 most cited documents (see Supplementary Materials A), a pattern in definitions was clear (e.g. in sources, wording). Most of these 50 documents used secondary sources to defining MSP, in many cases the same ones. These amounted to a total of 30 'defining' documents (see Figure 1 and Supplementary Materials B). The 30 defining

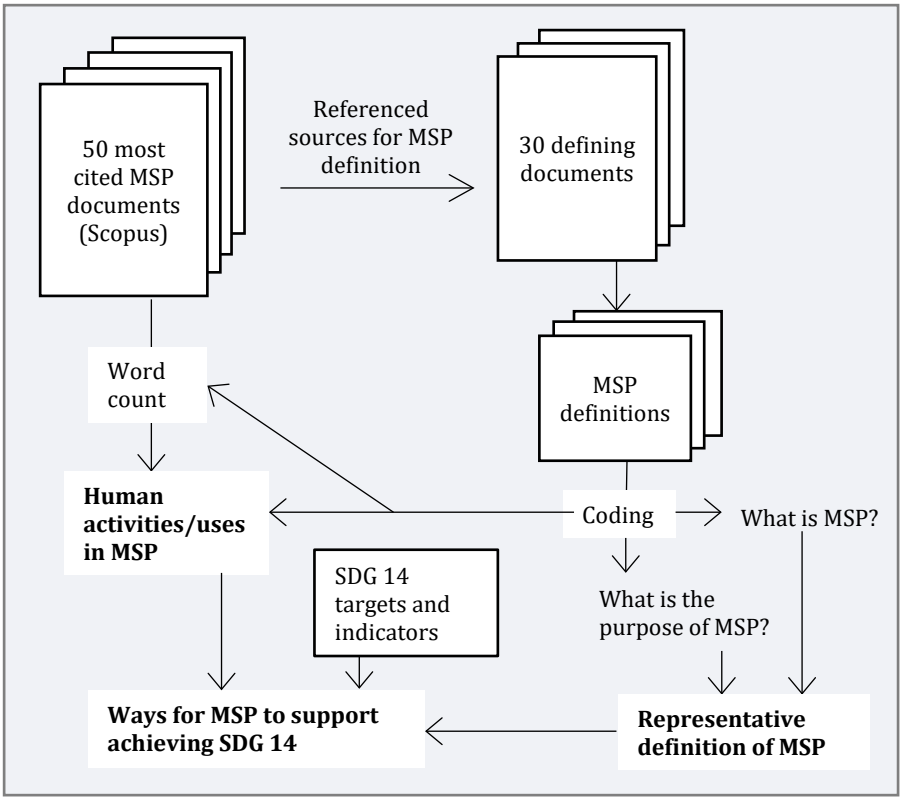

Figure 1. Illustration of the methodological process used to establish a representative MSP definition, analyse human uses addressed in MSP, and investigate the contribution of MSP to each target of the SDG 14.

documents were carefully examined for explicit MSP definitions, which were then extracted for further analysis using Nvivo [18], and coded based on two overall questions: (1) What is MSP? (2) What is the purpose of MSP? Each of these coding processes led to a list of answers. The most applied elements were then sought combined into one representable definition of MSP. This required some creativity in how to bind all the elements together into one formulation, for which the wording of the coded definitions was used as guidance. In order to test the representativeness of the formulated definition, the latter was compared with a word frequency test (of all definitions from the 30 defining sources) using Nvivo (see Figure 4 and Supplementary Materials C). This comparison made it possible to see if any central terms or aspects of MSP were missing from the formulation of the combined MSP definition.

Second, the set of 30 defining documents were manually reviewed for an examination of the human uses and activities that take place in ocean space, and which can be generally addressed and managed through MSP processes (see Supplementary Materials B). This analysis allows for a comparison of the type of ocean uses and activities that MSP can plan for and the uses and activities addressed in the SDG 14 targets. Based on the identified human uses and activities, a list of search words (see Supplementary Materials D) was then established and used to perform a word count for the 50 most cited MSP-documents, in order to assess which ocean uses gathered most attention.

Finally, by using the results of the first two stages, a qualitative analysis was developed to unravel the potential contribution of MSP to achieving SDG 14 (see Figure 1). This analysis used a list of search words related to each of the ten SDG 14 targets (see Supplementary Materials E) and focused on a manual review of the 50 most cited MSP documents – which were investigated regarding how MSP could contribute to achieving each of the targets. Additional relevant sources were also consulted for guidance about which specific actions could be undertaken by MSP initiatives, especially when considering the set of ocean uses MSP can plan for.

3 Defining marine spatial planning

The in-depth analysis of the 30 defining MSP documents resulted in a list of terms commonly used to describing “what MSP is”, some of them being more often referred (Figure 2). The most common terminology, mentioned in eleven of the defining documents, described MSP as being some type of “process” (either in general terms, or, more specifically, as a planning or public process). As well, five documents described MSP as being a type of “management”, and three documents as being a way to implement the ecosystem-based approach (EBA) (albeit there are some disagreements as to whether MSP implements EBA or is

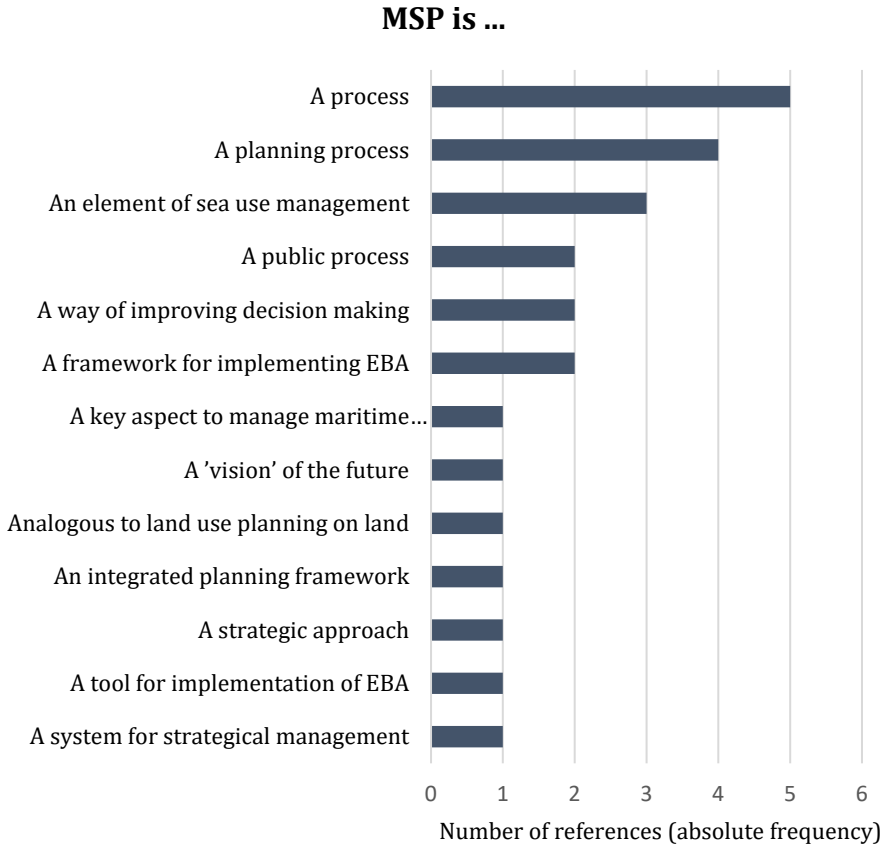

Figure 2 Main definitions of what MSP is, found in the 30 'defining' documents. Five out of the 30 documents only defined what MSP does and not what MSP is. For that reason, they are not reflected into the graphic. Baseline data in Supplementary Materials B

part of ecosystem-based management [19]).

By combining the most applied terms, a preliminary MSP definition could be described as follows:

"Marine spatial planning is ***a public, planning process*** *and an* ***element of ecosystem-based sea use management****."*

During this preliminary search, the multifunctional purpose of MSP became vivid, with the 30 defining documents providing a long list of purposes for MSP

(Figure 3). A shared element of the listed purposes was the focus on human uses and maritime activities, namely concerning solving potential conflicts among uses and between uses and the environment. A peculiar aspect, especially relevant when considering the role of MSP in achieving SDG 14, is that purposes including the words "sustainability" or "sustainable" are not among the top purposes in Figure 3. Indeed, among the twenty-one identified purposes, 'Support sustainable development' and 'Manage activities more sustainably' appear only in the 12th and 21st positions, respectively. Still, some of the most frequently mentioned purposes also relate to sustainability concepts. This is the case of 'Achieve ecological, economic and social objectives', the second most identified purpose (mentioned in 13 out of the 30 documents), which addresses the three pillars of sustainable development; and 'Sustain ecosystem services', the fifth most identified purpose (7 out of 30 documents).

Adding the purpose to the summarized description obtained earlier, MSP could be described as:

> *"Marine spatial planning is* ***a public, planning process*** *and* ***an element of ecosystem-based sea use management,*** *that aims to prevent* ***conflicts among maritime uses and between human uses and the environment,*** *through a* ***strategic*** *and* ***rational, spatial and temporal, distribution of activities*** *in order* ***to achieve environmental, social and economic objectives,*** *such as* ***sustaining ecosystem services*** *and* ***improve decision-making.*** *The process involves the implementation of* ***environmental protection ,*** *the facilitation of* ***co-location of compatible*** *uses, and the assessment and management of* ***cumulative impacts****."*

When comparing the formulation above with the word frequency test performed on the MSP definitions from the 30 defining documents, it became evident that this formulation was a valid representation of the word cloud (Figure 4).

The absence of sustainability concepts is however once again evident. In effect, not a single sustainability concept appears among the 40 most applied words that constitute the word cloud. The word 'sustainable' is the 95th most cited word, and therefore not displayed in the word cloud. By contrast, in the MSPD there is a substantive emphasis on sustainability. The word 'sustainable' is the 11th most cited word (when excluding the term 'maritime spatial planning), being written 25 times over 11 pages [20] and being the second most cited environmental-related word [21].

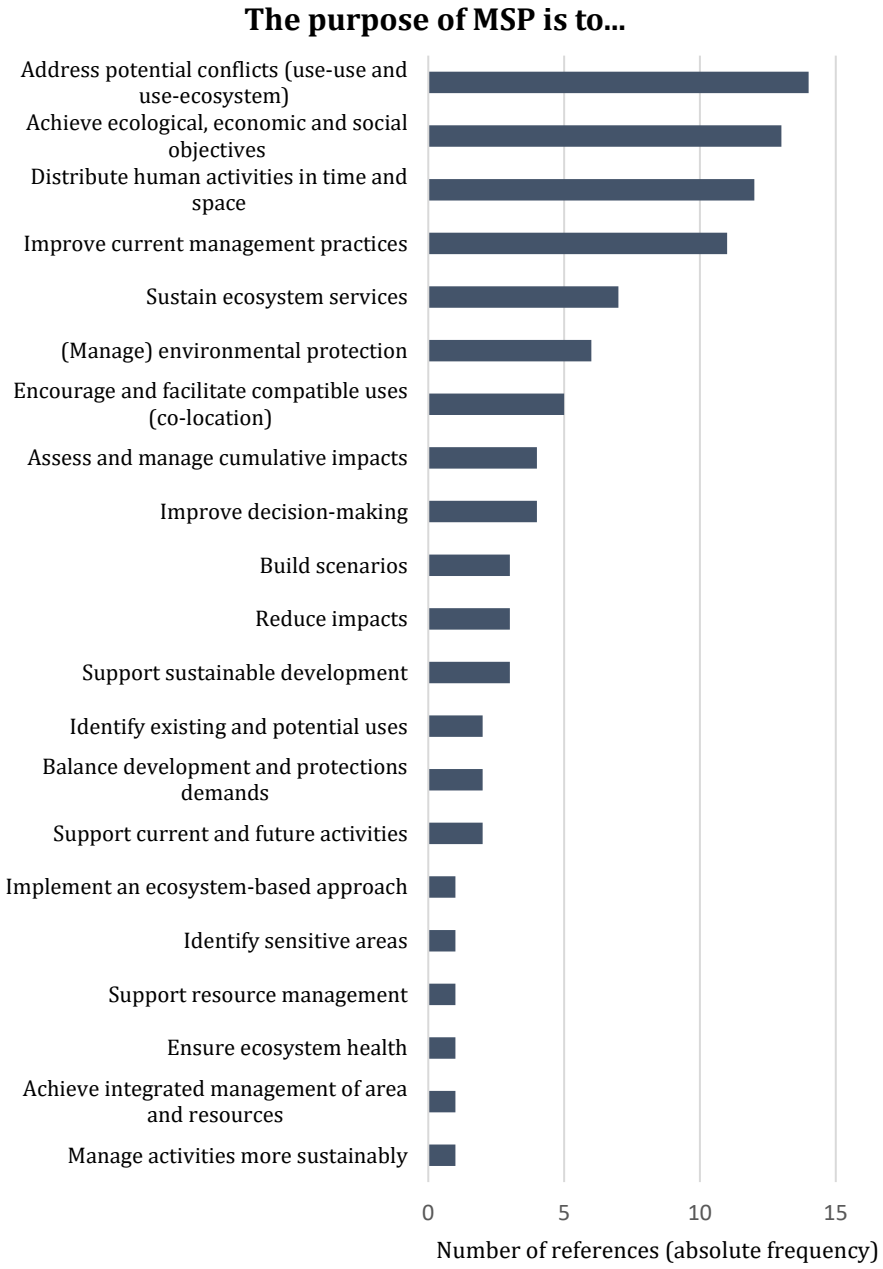

Figure 3: Purposes of MSP found in the 30 'founding' documents and the number of times each purpose appears in such documents. Baseline data in Supplementary Materials B.

Figure 4. Word cloud generated by Nvivo based on the definitions of MSP found in the 30 defining documents. The words 'marine', 'spatial', and 'planning' were excluded from the word frequency analysis in order not to influence results. The size of each word represents the percentage of all citations relative to the other words. Baseline data can be found in Supplementary Materials C.

4 Human activities and uses to address through marine spatial planning

The list of human uses and activities mentioned in the 30 defining documents is displayed in Figure 5, together with the corresponding word frequency results for the 50 most cited MSP documents. The list of uses and activities in Figure 5 is diverse, and spans from on-shore, coastal activities (e.g. tourism, ports and harbour activities) to off-shore activities (e.g. renewable energy, oil and gas activities, shipping, off-shore aquaculture). Many of these activities also correspond to sectors that were traditionally managed separately and through different institutional setups [9]. Moreover, while some activities are managed nationally, others have a more transboundary nature. For example, where tourism is mainly managed at the country level, shipping and fishing activities are also managed through international frameworks, such as the International

Council for the Exploration of the Seas [22] and the International Maritime Organization [23] [9,24].

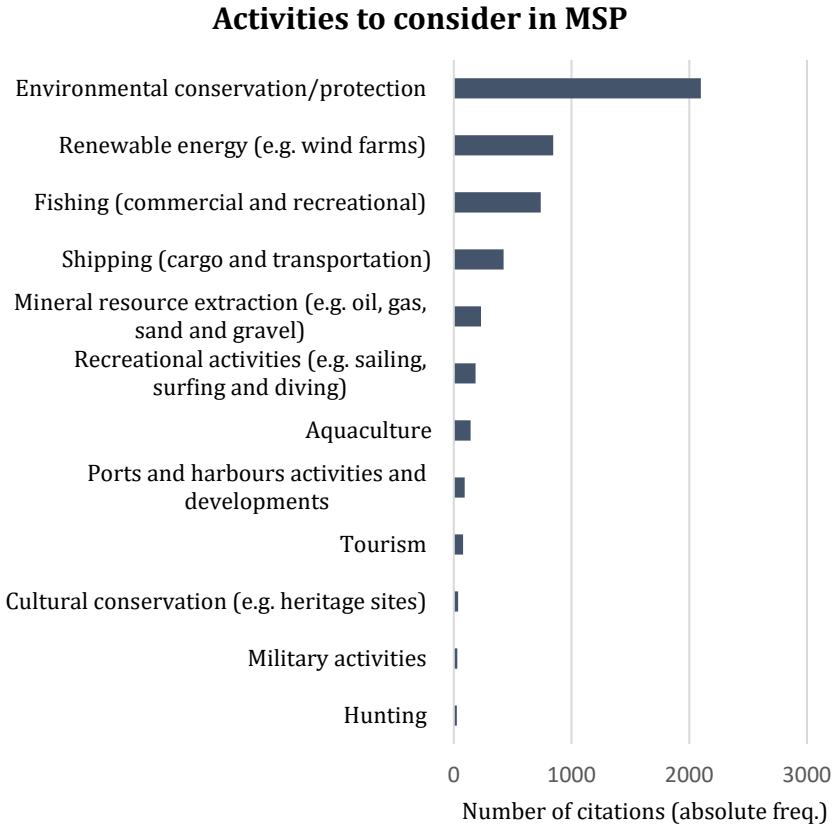

Figure 5. A word count on key activities that can be addressed through MSP.

The word count showed that some activities receive much more attention in the MSP context. The most cited uses of the ocean space are those related to marine conservation and protection, renewable energy activities, and fishing (Figure 5). These activities are all known to be prone to conflicts, either among themselves or between them and other activities or stakeholders. Conflicts among the three activities can occur for example when fisheries are excluded from a new protected area or from a wind farm area [25,26]. Conflicts with stakeholders and other activities are often seen in relation to the establishment of a new wind farm, where conflicting interests of coastal residents and shipping and

recreational activities exist [26,27]. The level of potential conflicts surrounding these activities might explain the high citation numbers in the analysed literature.

5 The role of marine spatial planning in achieving SDG 14

The limited use of sustainability concepts in MSP definitions (discussed in Section 3) is noteworthy, and especially relevant when considering the contribution of MSP to achieving SDG 14. This raises the question: Can MSP play an important role in achieving SDG 14, in spite of the lack of sustainability focus in the studied 'defining' MSP documents? To address this question, results from the analysis of links between MSP and each SDG 14 target are presented below and summarized in Table 2.

Target 14.1. Marine pollution

The first SDG 14 target points to a sensitive issue in MSP. First, being a 'spatial' practice to which extent can MSP regulate pollution from sectoral activities? Second, being a 'marine' practice what is the potential for MSP to address land-based pollution sources? The indicator of target 14.1 is composed of two separate sub-indicators: (a) an index of coastal eutrophication; and (b) floating plastic debris density. Eutrophication is strongly linked to nutrient runoff from agricultural activities, and plastic debris has been found to derive primarily from land-based sources (c. 80% [28,29]). While eutrophication is one of the key impacts (together with overfishing and ocean acidification) that the UN considered to be impossible to address with the current level of protection at sea, the need to address land-based sources of pollution gets further emphasis. In one of the 30 defining MSP documents, the authors suggested that MSP can play a role in formulating regulations for "*the amount of fertilizers and pesticides applied to agriculture lands*"[27]. Ehler and Douvere (2009) suggest this as a non-spatial management measure that might be necessary, albeit seldom applied, to achieve MSP objectives. However, the role of MSP in addressing what is called 'land-sea interactions' (LSI) has been a topic for much debate and confusion. Indeed, in 2017 MSP practitioners met at a conference to discuss the topic of how to address land-sea interactions in MSP [30]. The practice of addressing LSI in MSP is however still limited and highly debated. A full integration and merge of terrestrial and marine spatial planning has been suggested as a way to facilitate better considerations for LSI, but it bears a number of challenges [30–32]. While pollution from land is a dominant impact on marine ecosystems, some pollution derives from maritime activities, such as lost fishing gear and oil spills. In this regard, it has been suggested that MSP could address the amount of lost fishing gear by making restriction zones for specified types of gear, such as bottom

trawls [24], and that MSP could cooperate with the development of risk and vulnerability analyses related to oil spills due to the shared spatial dimension of the two processes and a similar demand for data [33].

Target 14.2. Manage and protect marine and coastal ecosystems

With the purpose of avoiding adverse impacts on the marine environment, this target aims for a sustainable management and protection of marine and coastal ecosystems. The aim of target 14.2 is in line with the initial purpose of MSP, as exemplified for example by the case of the Great Barrier Reef Marine Park. The practice of MSP was originally considered (and is today still) a means to implement ecosystem-based management [34] – as seen in the coded definitions. By implementing EBA, MSP could play a key role in achieving target 14.2, as the indicator pertains to the "*number of countries using ecosystem-based approaches to managing marine areas*"[17]. Indeed, three of the most cited 'purposes' of MSP, as displayed in Figure 3, are related to target 14.2 (namely, manage 'environmental protection', 'assess and manage cumulative impacts' and 'reduce impacts'), all of them being key elements of EBA [19]. As suggested by the 'defining' documents (e.g. [24,34,35]), this indicates a high potential for MSP to contribute to target 14.2. The assessment of cumulative impacts has also been identified as of high importance if MSP is to prevent adverse environmental impacts [36]. Indeed, MSP can play a key role in reducing impacts on the marine environment through spatial restrictions (e.g. restrictions towards the use of bottom-trawling gear in certain areas), or restrictions of the total extent/intensity of high impact activities such as fishing, oil and gas extraction, and shipping [24,27].

Target 14.3. Minimize and address the impacts of ocean acidification

Ocean acidification takes place because of the rising concentration of carbon dioxide in the atmosphere, which is absorbed by, and thus acidifies, the ocean [37]. While climate change in general is often neglected in MSP process, there are several potential pathways for how MSP can minimise and address climate-related impacts, including the ones from ocean acidification [6]. Target 14.3 focuses on reducing and addressing the impacts of acidification, and this can include actions for climate change mitigation such as the development of wind farms. Indeed, by supporting the development of renewable energy production, allocating areas to blue carbon capture and storage, or limiting available space for high-emission activities [6], MSP can play a key role in national strategies for climate change mitigation and thus the reduction of ocean acidification. Adverse impacts from acidification on marine species include reduced calcification and growth rates in skeletons and shells, changes in metabolism and in ecological

connectivity [37,38]. These impacts influence the services that marine ecosystems deliver, something that MSP is intended to protect according to seven of the 30 defining MSP documents (see Figure 3). Ensuring healthy ecosystems and a good environmental status becomes even more relevant in face of climate change, as it provides for more resilient ecosystem components, thus increasing the chance of survival and potential adaptation to a more acidic environment [38]. MSP can also contribute to such resilience by reducing non-climate related impacts from for example pollution, overfishing and habitat loss [6] (Ehler and Douvere, 2009; Rilov et al. 2020). Increasing ecosystem resilience is part of target 14.2, and actions in MSP to increase ecosystem resilience will therefore support both the achievement of targets 14.2 and 14.3.

Target 14.4. Effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices

The fourth target of the SDG 14 puts focus on the management of fishing activities with the goal to prevent the depletion of fish stocks. MSP can regulate the type and intensity of fishing activities within specified areas. No-take zones and zones where certain fishing equipment is not allowed (such as bottom trawls) have been found effective in securing benefits for both conservation and fishing [24]. While the creation of specific zones is one way that MSP can contribute to the achievement of target 14.4, indicator 14.4.1 focuses on the "*Proportion of fish stocks within biologically sustainable levels*" [17] which indicates the need for a more holistic management of fishing activities – something that cannot be ensured solely through zoning. In addition to zoning procedures, MSP has been suggested to regulate fishing activities by supporting the implementation of non-economic incentives and regulations (e.g. setting limits for allowable catches) [27]. While illegal, unreported and unregulated (IUU) fishing activities are difficult to manage through any planning or management initiative – MSP included – some spatial actions have been found to change IUU fishing activities indirectly. This is the case, for example, of establishing artificial reefs, which discourage potential IUU trawling in the area [39].

Target 14.5 Conserve at least 10 per cent of coastal and marine areas

Conservation was the most cited use of the ocean space in Section 4 (Figure 5), and is seen as a key activity in MSP. A widespread way to ensuring conservation at sea is through the establishment of marine protected areas (MPAs). MPAs are, as well, the measuring factor of indicator 14.5.1: "*Coverage of protected areas in*

relation to marine areas" [17]. MPAs can be defined as an area "*which has been reserved by law or other effective means to protect part or all of the enclosed environment*"[40], and are generally considered as one of the most effective conservation tools [9,25]. Initially, the practice of establishing MPAs was a key inspiration for the development of MSP practice [34] and is now seen as a key element to ensuring an ecosystem-based approach in MSP [10,41,42]. However, research on MPAs shows that many protected areas do not have the intended conservation effect. This can occur for several reasons, from poor management to issues in the initial scoping and design of protected area [25]. MSP can play a vital role in addressing some of these challenges and improving the current practice of MPAs [25,42], thus further contributing to target 14.5.

Target 14.6 Prohibit certain forms of fisheries subsidies

None of the analysed literature suggested MSP as an ideal tool to the management of fisheries subsidies. This could be because of a clear lack of a spatial dimension in target 14.6. However**,** this target is strongly linked to target 14.4 (on the regulation of overfishing and IUU fisheries). Both targets aim to reduce the overall pressure from fisheries, with indicator 14.4.1 being dedicated to the status of fish stocks, and indicator 14.6.1 being more focused on management measures: "*Progress by countries in the degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing*" [17]. While indicator 14.6.1 does not focus on the prohibition of certain subsidies, it does focus on the implementation of instruments to combat IUU. As the latter was considered as challenging, but not impossible for MSP to contribute to under target 14.4, it might constitute an indirect pathway to further contributions of MSP to target 14.6.

Target 14.7 Increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources

Target 14.7 is the third target of SDG 14 to address fishing activities, the second most referred ocean use in Section 4 (Figure 5), with indicator 14.7.1 focusing on the economic development of sustainable fisheries: "*Sustainable fisheries as a percentage of GDP in small island developing States, least developed countries and all countries*" [17]. Small Island Developing States (SIDS) account for ca. 30 % of the worlds' exclusive economic zones, and have thus a tremendous influence on the well-being of marine ecosystem globally. SIDS are extremely dependent on the ocean, and strongly rely on the ocean resources for human wellbeing and livelihood. Fishery is the primary economy in many SIDS and is intrinsic to their culture and lifestyles [43]. However, target 14.7 goes further, focussing on activities other than fishing, such as sustainable aquaculture and tourism, to

support the increase in economic benefits to SIDS and least developed countries. Fisheries, aquaculture and tourism are human activities commonly managed through MSP (Figure 5), and activities that rely on healthy ecosystems. The establishment of spatial restrictions (e.g. no-take protected areas, trawling-free zones) can therefore play an important role in supporting their sustainable development. For example, the definition of zones to the development of ecosystem-friendly tourism activities can provide important revenues, as well as better conditions for sustainable fishing activities [34,44]. MSP can also facilitate the development of aquaculture in a strategic manner, by planning for a varied selection of aquaculture types and prioritising least polluting activities, such as the cultivation of seaweeds, oysters and mussels [45]. However, due to the connectivity of the ocean and the mobility of marine species, local human activities depend largely on the activities that take place further off-shore [46]. It is therefore important to consider the indirect contribution of MSP to target 14.7 through the role played in regards to other targets (e.g. targets 14.4 and 14.5).

Target 14.a. Increase scientific knowledge, develop research capacity and transfer marine technology

Target 14.a focuses on increasing scientific knowledge and research capacity, in order to improve ocean health and marine biodiversity contribution to the development of developing countries, and is evaluated based on indicator 14.a.1 on the "*Proportion of total research budget allocated to research in the field of marine technology*" [17]. As MSP is a highly data-demanding practice, it often involves a large extent of data collection and analysis (Ehler and Douvere, 2009). MSP requires data on existing habitats, flora and fauna, existing and future maritime activities, and expected ecological, social and economic changes (including from climate change). Such data can be generated through geo-technologies such as remote sensing and data analysis in geographic information systems [34,47]. Thus, as formulated by Douvere (2008), MSP "*provides a management framework for new and previously inaccessible scientific information*". It is therefore an ideal gateway for meeting 14.a, basing on the premise that data and technologies generated in MSP processes are made available to other usage and broader ocean management contexts. As target 14.a has a specific aim "*to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries*"[17], the process of resource demanding data collection for MSP is an issue. As scientific research can be very costly, SIDS are more restricted than other states in meeting this target [27,48,49].

Target 14.b. Provide access for small-scale artisanal fishers to marine resources and markets

Target 14.b is evaluated based on the "*Progress by countries in the degree of application of a legal/regulatory/policy/institutional framework which recognizes and protects access rights for small-scale fisheries*" (indicator 14.b.1). Because of its intrinsic characteristics, MSP can constitute such a framework. The most obvious role of MSP in this matter pertains to ensuring spatial access of small-scale fisheries to marine resources, for example, by establishing zones where only recreational and artisanal fishing are allowed, or where they have priority over other ocean uses [24]. However, MSP can also facilitate better access to markets, for example, by promoting communication among stakeholders. Stakeholder meetings, a key element of MSP, can bring actors in the fishing industry together, which in turn might facilitate new agreements and collaborations between small-scale fishers and market holders [50,51].

Target 14.c. Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS

The last target of SDG 14, target 14.c, focuses on nations implementation of international law, according to what is established in the United Nation Convention on the Law of the Sea (UNCLOS). Although UNCLOS does not refer to MSP as a concept, it does consider spatial planning as a facilitating tool that allows some countries to fulfil obligations within UNCLOS [9,41]. Indeed, the spatial boundaries set by UNCLOS, such as Territorial Waters and Exclusive Economic Zones, together with specifications for domestic rights within each zone, confirms the potential role to be played by MSP in managing marine resources (both living and non-living) within national jurisdictions [52]. While there is also a strong push for developing MSP initiatives in areas beyond national jurisdiction [53], international initiatives in the high seas are still scarce making MSP a predominantly national-level activity [41]. When considering the close connections between the legal framework of UNCLOS and MSP, especially in an ecosystem-based context, it can be said that any country with ongoing MSP initiatives is "*making progress in (…) implementing (…) ocean-related instruments that implement international law"* with the aim to "*enhance the conservation and sustainable use of oceans and their resources"* [17] thus contributing to target 14.c.

Table 2. Summary of Section 4 on the potential contribution of MSP in meeting each of the ten targets of the UN SDG 14 (the full description of SDG 14 targets and indicators can be found in Table 1).

TARGET	Actions to be carried in MSP initiatives
14.1. Prevent and significantly reduce marine pollution of all kinds	• Encourage and support full integration with terrestrial planning • Exclusion of bottom-trawling activities from certain areas to prevent lost fishing gear • Cooperation with risk and vulnerability analyses carried for human hazards such as oil spills • Contribute to regulations for the amount of fertilizers and pesticides applied to agriculture
14.2. Sustainably manage and protect marine and coastal ecosystems	• Apply an ecosystem-based approach • Assess cumulative impacts • Establish spatial restrictions for high impact activities (e.g. fishing, oil and gas extraction or shipping) in particularly important marine areas • Allocate marine space for conservation areas
14.3. Minimize and address the impacts of ocean acidification	• Contribute to a green transition by prioritising renewable energy developments (e.g. wind, wave and tidal) and reducing high-CO2 emitting activities (e.g oil and gas, shipping) • Contribute to increased resilience of ecosystems by reducing non-climate human pressures (e.g. from pollution, overfishing and habitat losses)
14.4. Effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing	• Establish 'no-take' marine zones • Establish 'trawling-free' marine zones • Regulate fishing activities through non-economic incentives and regulations (e.g. by setting limits for allowable catches) • Discourage IUU fishing activities (e.g. by establishing artificial reefs)
14.5. Conserve at least 10 per cent of coastal and marine areas	• Support the establishment of marine protected areas (MPAs) in at least 10 % of the marine area • Ensure that MPAs are ecologically beneficial • Ensure proper monitoring and enforcement of MPAs
14.6. Prohibit certain forms of fisheries subsidies	• Combat IUU and overfishing through initiatives mentioned in target 14.4
14.7. Increase the economic benefits to	• Support the development of sustainable fishing practices (e.g. by establishing MPAs, no-take

Small Island developing States and least developed countries from the sustainable use of marine resources	zones or trawling-free zones to ensure healthy fish stocks) • Prioritize the allocation of space to eco-tourism • Prioritise zones for less polluting aquaculture activities (e.g. cultivation of seaweed, oysters and mussels)
14.a. Increase scientific knowledge, develop research capacity and transfer marine technology	• Identify knowledge gaps when assessing environmental impacts and ocean health • Use geo-technologies such as remote sensing and GIS for the generation of new data and development of technologies • Make data and technologies available for other usage and further development
14.b. Provide access for small-scale artisanal fishers to marine resources and markets	• Prioritize areas to small-scale fisheries • Facilitate access to markets through stakeholder involvement and capacity building
14.c. Enhance the conservation and sustainable use of oceans and their resources by implementing international law	• Develop marine spatial plans in compliance with UNCLOS

6 Discussion and conclusions

It is clear from this study that the practice of MSP can play an important role in ensuring sustainability for life below water and achieving SDG 14. However, it also became clear that while MSP is an ideal tool for some SDG 14 targets, others cannot be properly addressed through MSP and require alternative management approaches. In particular, spatial management measures like the establishment of conservation areas, such as MPAs, and restriction zones for fisheries, such as no-take zones or trawl-free zones, can contribute to the achievement of six out of the ten SDG 14 targets.

Targets with a spatial dimension – such as targets 14.2 on sustainable ocean use, 14.5 on establishing MPAs, or 14.7 on fisheries, tourism and aquaculture in SIDS and least developed countries – are highly compatible with MSP practice. Indeed, the establishment of areas where certain types of fishing are prohibited would help in meeting several targets simultaneously (e.g. targets 14.2, 14.4, 14.5, 14.6 and 14.7), whereas the establishment of MPAs would contribute, both

directly and indirectly, to meeting targets 14.2, 14.5 and 14.c. By contrast, targets that require non-spatial regulations such as target 14.6 on fisheries subsidies, or that address topics that go beyond the marine realm such as target 14.1 on marine pollution from land-based activities, can be more challenging to address through MSP. Indeed, while target 14.1 emphasises the importance of considering land-sea interactions in MSP and ensuring ecosystems resilience to better endure impacts from marine pollution, ensuring this connection in practice is commonly challenging [54].

But while this research supports the relevance of MSP to SDG 14, it also acknowledges that the current practice of MSP rather prioritizes the achievement of economic objectives against environmental goals (although some MSP cases are truly ecosystem-based) [8]. Indeed, the assessment of MSP definitions showed a minimal attention to sustainability objectives and a high focus on how to manage human uses and potential conflicts, indicating a weak sustainability approach. This economic focus is reflected in the word cloud based on MSP definitions (Figure 3), in which the words 'uses' and 'activities' were the most frequently cited, and the words 'ecosystem' and 'sustainability' were far less predominant. The different prioritisation of environmental and economic objectives in MSP practices is not new, and mirrors the ongoing debate of whether MSP is an abbreviation for 'marine' or 'maritime' spatial planning. While some use 'marine' to indicate that the planning practice is ecosystem-based, and thus limited by ecosystem limits (with strong sustainability objectives), 'maritime' is often used in EU contexts (as in the MSPD) or to emphasise the cross-sectoral character of MSP [16,46,55]. While the choice of concepts does not in itself guarantee a particular outcome, the values associated with the terminology may play a role when objectives are set, and whether these aim for strong or weak sustainability objectives [16]. Thus, despite its conceptual relevance to SDG 14, current MSP practices and definitions show that MSP is not yet fulfilling its full potential.

We are currently living in the period of history with the largest deterioration of nature, and the trend is accelerating [56]. The latest report from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services estimates that the current rate of species extinction is at least tens to a hundred times higher than it has ever been over the last ten million years [56]. This extensive loss of biodiversity not only reduces ecosystems ability to deliver provisioning services, such as food, but it also decreases ecological resilience to overcome other anthropogenic threats such as climate change [56,57]. Not only does the ocean provide livelihoods and income for humans, it also supports human wellbeing through non-monetary values, and is in many countries central to both socioeconomic and cultural dimensions [58]. The current biodiversity

loss can lead to various undesirable futures depending on the actions, strategies and plans we make today [59]. This, together with the increasing need to achieve the SDG 14 for life below water emphasise the importance of implementing effective ecosystem-based MSP initiatives, with strong sustainability objectives that prioritise the health and resilience of the ocean above the achievement of blue growth objectives.

7 References

[1] UN, Transforming our world: the 2030 Agenda for Sustainable Development, A/RES/70/1, General Assembly, 2015. doi:10.1163/157180910X12665776638740.

[2] UN ECOSOC, Special edition: progress towards the Sustainable Development Goals, (2019). https://undocs.org/E/2019/68.

[3] C. Ehler, F. Douvere, Marine Spatial Planning: a step-by-step approach toward ecosystem-based management, Intergov. Oceanogr. Comm. Man Biosph. Program. IOC Manual (2009) 1–98. doi:Intergovernmental Oceanographic Commission and Man and the Biosphere Programme.

[4] European Commission, Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014, establishing a framework for maritime spatial planning, 2014.

[5] M. Ntona, E. Morgera, Connecting SDG 14 with the other Sustainable Development Goals through marine spatial planning, Mar. Policy. 93 (2018) 214–222. doi:10.1016/j.marpol.2017.06.020.

[6] C. Santos, T. Agardy, F. Andrade, H. Calado, L.B. Crowder, C.N. Ehler, S. García-Morales, E. Gissi, B.S. Halpern, M.K. Orbach, H.-O. Pörtner, R. Rosa, Integrating climate change in ocean planning, Nat. Sustain. (2020). doi:10.1038/s41893-020-0513-x.

[7] H. Calado, C. Pegorelli, C. Frazão Santos, Maritime Spatial Planning and Sustainable Development, in: W. Leal Filho, A. Azul, L. Brandli, A. Lange Salvia, T. Wall (Eds.), Encycl. UN Sustain. Dev. Goals, Life Below Water., Springer International Publishing., 2020.

[8] B. Trouillet, Reinventing marine spatial planning: a critical review of initiatives worldwide, J. Environ. Policy Plan. 0 (2020) 1–19. doi:10.1080/1523908X.2020.1751605.

[9] F. Maes, The international legal framework for marine spatial planning,

Mar. Policy. 32 (2008) 797–810. doi:10.1016/j.marpol.2008.03.013.

[10] S. Katsanevakis, V. Stelzenmüller, A. South, T.K. Sørensen, P.J.S. Jones, S. Kerr, F. Badalamenti, C. Anagnostou, P. Breen, G. Chust, G. D'Anna, M. Duijn, T. Filatova, F. Fiorentino, H. Hulsman, K. Johnson, A.P. Karageorgis, I. Kröncke, S. Mirto, C. Pipitone, S. Portelli, W. Qiu, H. Reiss, D. Sakellariou, M. Salomidi, L. van Hoof, V. Vassilopoulou, T. Vega Fernández, S. Vöge, A. Weber, A. Zenetos, R. ter Hofstede, Ecosystem-based marine spatial management: Review of concepts, policies, tools, and critical issues, Ocean Coast. Manag. 54 (2011) 807–820. doi:10.1016/j.ocecoaman.2011.09.002.

[11] P.M. Gilliland, D. Laffoley, Key elements and steps in the process of developing ecosystem-based marine spatial planning, 32 (2008) 787–796. doi:10.1016/j.marpol.2008.03.022.

[12] F. Douvere, C. Ehler, Introduction, Mar. Policy. 32 (2008) 759–761. doi:10.1016/j.marpol.2008.03.019.

[13] P.J.S. Jones, L.M. Lieberknecht, W. Qiu, Marine spatial planning in reality: Introduction to case studies and discussion of findings, Mar. Policy. 71 (2016) 256–264. doi:10.1016/j.marpol.2016.04.026.

[14] I.J. Bateman, G.M. Mace, The natural capital framework for sustainably efficient and equitable decision making, Nat. Sustain. (2020). doi:10.1038/s41893-020-0552-3.

[15] C.F. Santos, T. Domingos, M.A. Ferreira, M. Orbach, F. Andrade, How sustainable is sustainable marine spatial planning? Part I-Linking the concepts, Mar. Policy. 49 (2014) 59–65. doi:10.1016/j.marpol.2014.04.004.

[16] L.D. Mee, R.L. Jefferson, D. d. A. Laffoley, M. Elliott, How good is good? Human values and Europe's proposed Marine Strategy Directive, Mar. Pollut. Bull. 56 (2008) 187–204. doi:10.1016/j.marpolbul.2007.09.038.

[17] UN, Goal 14, Sustain. Dev. Knowl. Platf. (2018). https://sustainabledevelopment.un.org/sdg14 (accessed January 31, 2019).

[18] Nvivo, Qualitative Data Analysis Software | NVivo, (2020). https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home (accessed September 14, 2020).

[19] T.S. Kirkfeldt, An ocean of concepts: Why choosing between ecosystem-based management, ecosystem-based approach and ecosystem approach makes a difference, Mar. Policy. 106 (2019) 103541. doi:10.1016/j.marpol.2019.103541.

[20] T.S. Kirkfeldt, J.P.M. Van Tatenhove, H.N. Nielsen, S. V Larsen, An ocean of ambiguity in Northern European marine spatial planning policy designs, Mar. Policy. 119 (2020) 104063. doi:10.1016/j.marpol.2020.104063.

[21] C. Frazão Santos, M. Orbach, H. Calado, F. Andrade, Challenges in implementing sustainable marine spatial planning: The new Portuguese legal framework case, Mar. Policy. 61 (2015) 196–206. doi:10.1016/j.marpol.2015.08.010.

[22] ICES, Welcome to ICES, (2020). https://www.ices.dk/Pages/default.aspx (accessed September 18, 2020).

[23] IMO, International Maritime Organization, (2020). http://www.imo.org/en/Pages/Default.aspx (accessed September 18, 2020).

[24] T. Blundell, Turning the Tide: Addressing the Impact of Fisheries on the Marine Environment, R. Comm. Environ. Pollution. Parlamient UK. (2004) 497. http://www.gov.scot/Publications/2006/06/05151958/0.

[25] T. Agardy, G.N. di Sciara, P. Christie, Mind the gap: Addressing the shortcomings of marine protected areas through large scale marine spatial planning, Mar. Policy. 35 (2011) 226–232. doi:10.1016/j.marpol.2010.10.006.

[26] C. White, B.S. Halpern, C. V. Kappel, Ecosystem service tradeoff analysis reveals the value of marine spatial planning for multiple ocean uses, Proc. Natl. Acad. Sci. U. S. A. 109 (2012) 4696–4701. doi:10.1073/pnas.1114215109.

[27] C.N. Ehler, F. Douvere, Marine Spatial Planning: A Step-by-Step Approach towards Ecosystem-based Management, Paris, 2009.

[28] Eunomia, Plastics in the Marine Environment , 2016.

[29] J.R. Jambeck, R. Geyer, C. Wilcox, T.R. Siegler, M. Perryman, A. Andrady, R. Narayan, K.L. Law, Plastic waste inputs from land into the ocean,

Science (80-.). 347 (2015) 768–771. doi:10.1126/science.1260352.

[30] S. Kidd, H. Jones, S. Jay, Taking Account of Land-Sea Interactions in Marine Spatial Planning, in: J. Zaucha, K. Gee (Eds.), Marit. Spat. Planning, Past, Present. Futur., Palgrave Macmillan UK, 2019.

[31] EC, Maritime Spatial Planning: Addressing Land-Sea Interaction A briefing paper, 2017.

[32] S. Kidd, G. Ellis, From the Land to Sea and Back Again? Using Terrestrial Planning to Understand the Process of Marine Spatial Planning, J. Environ. Policy Plan. 14 (2012) 49–66. doi:10.1080/1523908X.2012.662382.

[33] C. Frazão Santos, J. Michel, M. Neves, J. Janeiro, F. Andrade, M. Orbach, Marine spatial planning and oil spill risk analysis: Finding common grounds, Mar. Pollut. Bull. 74 (2013) 73–81. doi:10.1016/j.marpolbul.2013.07.029.

[34] F. Douvere, The importance of marine spatial planning in advancing ecosystem-based sea use management, Mar. Policy. 32 (2008) 762–771. doi:10.1016/j.marpol.2008.03.021.

[35] C.N. Ehler, F. Douvere, Visions for a sea change, Report of the first international workshop on marine spatial planning, UNESCO, Paris, 2007.

[36] B.S. Halpern, K.L. McLeod, A.A. Rosenberg, L.B. Crowder, Managing for cumulative impacts in ecosystem-based management through ocean zoning, Ocean Coast. Manag. 51 (2008) 203–211. doi:10.1016/j.ocecoaman.2007.08.002.

[37] IPCC, Special Report on the Ocean and Cryosphere in a Changing Climate , (2019). https://www.ipcc.ch/srocc/ (accessed October 20, 2020).

[38] Committee on the Development of an Integrated Science Strategy for Ocean Acidification Monitoring, ed., Ocean acidification: a national strategy to meet the challenges of a changing ocean, National Academies Press, 2010.

[39] M.J. Bishop, M. Mayer-Pinto, L. Airoldi, L.B. Firth, R.L. Morris, L.H.L. Loke, S.J. Hawkins, L.A. Naylor, R.A. Coleman, S.Y. Chee, K.A. Dafforn, Effects of ocean sprawl on ecological connectivity: impacts and solutions, J. Exp. Mar. Bio. Ecol. 492 (2017) 7–30. doi:10.1016/j.jembe.2017.01.021.

[40] B.G. Lascelles, G.M. Langham, R.A. Ronconi, J.B. Reid, From hotspots to site protection: Identifying Marine Protected Areas for seabirds around the globe, Biol. Conserv. 156 (2012) 5–14. doi:10.1016/j.biocon.2011.12.008.

[41] J. Ardron, K. Gjerde, S. Pullen, V. Tilot, Marine spatial planning in the high seas, Mar. Policy. 32 (2008) 832–839. doi:10.1016/j.marpol.2008.03.018.

[42] G. Rilov, S. Fraschetti, E. Gissi, C. Pipitone, F. Badalamenti, L. Tamburello, E. Menini, P. Goriup, A.D. Mazaris, J. Garrabou, L. Benedetti-Cecchi, R. Danovaro, C. Loiseau, J. Claudet, S. Katsanevakis, A fast-moving target: achieving marine conservation goals under shifting climate and policies, Ecol. Appl. 30 (2020) 1–14. doi:10.1002/eap.2009.

[43] R. Jumeau, Expert Group Meeting on Oceans, Seas and Sustainable Development: Implementation and follow-up to Rio+20 Small Island Developing States, Large Ocean States, United Nations Headquarters, 2013.

[44] K.K. Arkema, G.M. Verutes, S.A. Wood, C. Clarke-samuels, S. Rosado, Embedding ecosystem services in coastal planning leads to better outcomes for people and nature, PNAS. 112 (2015) 7390–7395. doi:10.1073/pnas.1406483112.

[45] A.D. Guerry, M.H. Ruckelshaus, K.K. Arkema, J.R. Bernhardt, G. Guannel, C. Kim, M. Marsik, M. Papenfus, J.E. Toft, G. Verutes, S.A. Wood, M. Beck, K.M.A. Chan, G. Gelfenbaum, B.D. Gold, S. Benjamin, W.B. Labiosa, S.E. Lester, P.S. Levin, M.L. Pinsky, M. Plummer, S. Polasky, D.A. Sutherland, H. Tallis, A. Day, A.D. Guerry, M.H. Ruckelshaus, K.K. Arkema, J.R. Bernhardt, G. Guannel, C. Kim, M. Marsik, M. Papenfus, J.E. Toft, S.A. Wood, M. Beck, F. Chan, K.M.A. Chan, G. Gelfenbaum, B.D. Gold, B.S. Halpern, W.B. Labiosa, S.E. Lester, P.S. Levin, M. Mcfield, M.L. Pinsky, M. Plummer, S. Polasky, P. Ruggiero, A. Sutherland, H. Tallis, A. Day, J. Spencer, Modeling benefits from nature: using ecosystem services to inform coastal and marine spatial planning, Int. J. Biodivers. Sci. Ecosyst. Serv. Manag. 3732 (2012) 2151–3740. doi:10.1080/21513732.2011.647835.

[46] K. Gee, J. Zaucha, Maritime spatial planning: past, present, future, 2019. doi:10.1007/978-3-319-98696-8.

[47] K. St. Martin, M. Hall-Arber, The missing layer: Geo-technologies, communities, and implications for marine spatial planning, Mar. Policy. 32 (2008) 779–786. doi:10.1016/j.marpol.2008.03.015.

[48] FAO, The Blue Growth Initiative and Small Island Developing States (SIDS), 2014.

[49] C.N. Ehler, An introduction to marine spatial planning, 2013. http://www.coraltriangleinitiative.org/sites/default/files/resources/6_An Introduction to Marine Spatial Planning.pdf (accessed October 21, 2020).

[50] R. Lewison, A.J. Hobday, S. Maxwell, E. Hazen, J.R. Hartog, D.C. Dunn, D. Briscoe, S. Fossette, C.E. O'Keefe, M. Barnes, M. Abecassis, S. Bograd, N.D. Bethoney, H. Bailey, D. Wiley, S. Andrews, L. Hazen, L.B. Crowder, Dynamic ocean management: Identifying the critical ingredients of dynamic approaches to ocean resource management, Bioscience. 65 (2015) 486–498. doi:10.1093/biosci/biv018.

[51] M. Gopnik, C. Fieseler, L. Cantral, K. McClellan, L. Pendleton, L. Crowder, Coming to the table: Early stakeholder engagement in marine spatial planning, Mar. Policy. 36 (2012) 1139–1149. doi:10.1016/j.marpol.2012.02.012.

[52] M. Papageorgiou, S. Kyvelou, Aspects of marine spatial planning and governance: Adapting to the transboundary nature and the special conditions of the sea, Eur. J. Environ. Sci. 8 (2018) 31–37. doi:10.14712/23361964.2018.5.

[53] G. Wright, K.M. Gjerde, D.E. Johnson, A. Finkelstein, M.A. Ferreira, D.C. Dunn, M.R. Chaves, A. Grehan, Marine spatial planning in areas beyond national jurisdiction, Mar. Policy. (2019) 0–1. doi:10.1016/j.marpol.2018.12.003.

[54] A. Schlüter, K. Van Assche, A.K. Hornidge, N. Văidianu, Land-sea interactions and coastal development: An evolutionary governance perspective, Mar. Policy. 112 (2020). doi:10.1016/j.marpol.2019.103801.

[55] A.J. Gilbert, K. Alexander, R. Sardá, R. Brazinskaite, C. Fischer, K. Gee, M. Jessopp, P. Kershaw, H.J. Los, D.M. Morla, C. O'Mahony, M. Pihlajamäki, S. Rees, R. Varjopuro, Marine spatial planning and Good Environmental status: A perspective on spatial and temporal dimensions, Ecol. Soc. 20

(2015). doi:10.5751/ES-06979-200164.

[56] S. Diaz, J. Settele, E. Brondízio, H.T. Ngo, M. Guèze, J. Agard Trinidad, A. Arneth, P. Balvanera, K. Brauman, R.T. Watson, I.A. Baste, A. Larigauderie, P. Leadley, U. Pascual, B. Baptiste, S. Demissew, L. Dziba, G. Erpul, A. Fazel, M. Fischer, A. María Hernández, M. Karki, V. Mathur, T. Pataridze, I. Sousa Pinto, M. Stenseke, K. Török, B. Vilá, M. Carneiro da Cunha, G.M. Mace, H. Mooney, Report of the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and ecosystem services of the work of the seventh session, Paris, 2019.

[57] E. Dinerstein, A.R. Joshi, C. Vynne, A.T.L. Lee, F. Pharand-Deschênes, M. França, S. Fernando, T. Birch, K. Burkart, G.P. Asner, D. Olson, A "global safety net" to reverse biodiversity loss and stabilize earth's climate, Sci. Adv. 6 (2020) 1–14. doi:10.1126/sciadv.abb2824.

[58] E.H. Allison, J. Kurien, Y. Ota, D.S. Adhuri, J.M. Bavinck, A. Cisneros-Montemayor, M. Fabinyi, S. Jentoft, S. Lau, T.G. Mallory, A. Olukoju, I. Van Putten, N. Stacey, M. Voyer, N. Weeratunge, The Human Relationship with Our Ocean Planet LEAD AUTHORS, Washington DC, 2020. https://oceanpanel.org/blue-papers/HumanRelationshipwithOurOceanPlanet (accessed October 22, 2020).

[59] C. Wyborn, F. Davila, L. Pereira, M. Lim, I. Alvarez, G. Henderson, A. Luers, M.J. Martinez Harms, K. Maze, J. Montana, M. Ryan, C. Sandbrook, R. Shaw, E. Woods, Imagining transformative biodiversity futures, Nat. Sustain. 3 (2020) 670–672. doi:10.1038/s41893-020-0587-5.

Supplementary Material

To the paper: A review of sustainability concepts in marine spatial planning and the potential to supporting the UN SDG 14

Contents:

Supplementary Material A. List of the 50 most cited documents on Scopus database that include MSP in their title, abstract or keywords.

Document	References for MSP
B.S. **Halpern**, S. Walbridge, K.A. Selkoe, C. V. Kappel, F. Micheli, C. D'Agrosa, J.F. Bruno, K.S. Casey, C. Ebert, H.E. Fox, R. Fujita, D. Heinemann, H.S. Lenihan, E.M.P. Madin, M.T. Perry, E.R. Selig, M. Spalding, R. Steneck, R. Watson, **A global map of human impact on marine ecosystems**, Science (80-.). 319 (2008) 948–952. doi:10.1126/science.1149345.	No explicit definition of MSP.
F. **Douvere**, **The importance of marine spatial planning in advancing ecosystem-based sea use management**, Mar. Policy. 32 (2008) 762–771. doi:10.1016/j.marpol.2008.03.021.	1. **DEFRA**. **A sea change**. A Marine Bill White Paper. In: Presented to parliament by the secretary of state for environment, food and rural affairs by command of Her Majesty. London, March 2007. 2. C.N. **Ehler,** F. **Douvere, Visions for a sea change, Report of the first international workshop on marine spatial planning,** UNESCO, Paris, 2007. 3. L. **Crowder,** E. **Norse, Essential ecological insights for marine ecosystem-based management and marine spatial planning,** Mar. Policy. 32 (2008) 772–778. doi:10.1016/j.marpol.2008.03.012.
K.M.A. **Chan,** A.D. Guerry, P. Balvanera, S. Klain, T. Satterfield, X. Basurto, A. Bostrom, R. Chuenpagdee, R. Gould, B.S. Halpern, N. Hannahs, J. Levine, B. Norton, M. Ruckelshaus, R. Russell, J. Tam, U. Woodside, **Where are cultural and social in ecosystem services? A framework for constructive engagement,** Bioscience. 62 (2012) 744–756. doi:10.1525/bio.2012.62.8.7.	No explicit definition of MSP.
T. **Agardy**, G.N. di **Sciara**, P. **Christie**, **Mind the gap: Addressing the**	No reference for own definition.

shortcomings of marine protected areas through large scale marine spatial planning, Mar. Policy. 35 (2011) 226–232. doi:10.1016/j.marpol.2010.10.006.	
L. **Crowder,** E. **Norse, Essential ecological insights for marine ecosystem-based management and marine spatial planning,** Mar. Policy. 32 (2008) 772–778. doi:10.1016/j.marpol.2008.03.012.	No reference for own definition.
R. **Pomeroy,** F. **Douvere, The engagement of stakeholders in the marine spatial planning process,** Mar. Policy. 32 (2008) 816–822. doi:10.1016/j.marpol.2008.03.017.	C.N. **Ehler,** F. **Douvere, Visions for a sea change, Report of the first international workshop on marine spatial planning,** UNESCO, Paris, 2007.
M.M. **Foley**, B.S. Halpern, F. Micheli, M.H. Armsby, M.R. Caldwell, C.M. Crain, E. Prahler, N. Rohr, D. Sivas, M.W. Beck, M.H. Carr, L.B. Crowder, J. Emmett Duffy, S.D. Hacker, K.L. McLeod, S.R. Palumbi, C.H. Peterson, H.M. Regan, M.H. Ruckelshaus, P.A. Sandifer, R.S. Steneck, **Guiding ecological principles for marine spatial planning,** Mar. Policy. 34 (2010) 955–966. doi:10.1016/j.marpol.2010.02.001.	1. F. **Douvere, The importance of marine spatial planning in advancing ecosystem-based sea use management,** Mar. Policy. 32 (2008) 762–771. doi:10.1016/j.marpol.2008.03.021. 2. B.S. **Halpern**, S. Walbridge, K.A. Selkoe, C. V. Kappel, F. Micheli, C. D'Agrosa, J.F. Bruno, K.S. Casey, C. Ebert, H.E. Fox, R. Fujita, D. Heinemann, H.S. Lenihan, E.M.P. Madin, M.T. Perry, E.R. Selig, M. Spalding, R. Steneck, R. Watson, **A global map of human impact on marine ecosystems,** Science. 319 (2008) 948–952. doi:10.1126/science.1149345. 3. C.N. **Ehler**, F. **Douvere, Marine Spatial Planning: A Step-by-Step Approach towards Ecosystem-based Management,** Paris, 2009.
B.S. **Halpern**, K.L. McLeod, A.A. Rosenberg, L.B. Crowder, **Managing for cumulative impacts in ecosystem-based management through ocean zoning,** Ocean Coast. Manag. 51 (2008) 203–211. doi:10.1016/j.ocecoaman.2007.08.002.	No reference for own definition.

B.P. **Wallace**, A.D. DiMatteo, B.J. Hurley, E.M. Finkbeiner, A.B. Bolten, M.Y. Chaloupka, B.J. Hutchinson, F. Alberto Abreu-Grobois, D. Amorocho, K.A. Bjorndal, J. Bourjea, B.W. Bowen, R.B. Dueñas, P. Casale, B.C. Choudhury, A. Costa, P.H. Dutton, A. Fallabrino, A. Girard, M. Girondot, M.H. Godfrey, M. Hamann, M. López-Mendilaharsu, M.A. Marcovaldi, J.A. Mortimer, J.A. Musick, R. Nel, N.J. Pilcher, J.A. Seminoff, S. Troëng, B. Witherington, R.B. Mast, **Regional Management Units for Marine Turtles: A Novel Framework for Prioritizing Conservation and Research across Multiple Scales,** PLoS One. 5 (2010) 1–11. doi:10.1371/journal.pone.0015465.	1. M.M. **Foley**, B.S. Halpern, F. Micheli, M.H. Armsby, M.R. Caldwell, C.M. Crain, E. Prahler, N. Rohr, D. Sivas, M.W. Beck, M.H. Carr, L.B. Crowder, J. Emmett Duffy, S.D. Hacker, K.L. McLeod, S.R. Palumbi, C.H. Peterson, H.M. Regan, M.H. Ruckelshaus, P.A. Sandifer, R.S. Steneck, **Guiding ecological principles for marine spatial planning**, Mar. Policy. 34 (2010) 955–966. doi:10.1016/j.marpol.2010.02.001. 2. L. **Crowder,** E. **Norse, Essential ecological insights for marine ecosystem-based management and marine spatial planning,** Mar. Policy. 32 (2008) 772–778. doi:10.1016/j.marpol.2008.03.012.
F. **Douvere**, C.N. **Ehler, New perspectives on sea use management: Initial findings from European experience with marine spatial planning,** J. Environ. Manage. 90 (2009) 77–88. doi:10.1016/j.jenvman.2008.07.004.	1. C.N. **Ehler,** F. **Douvere, Visions for a sea change, Report of the first international workshop on marine spatial planning,** UNESCO, Paris, 2007. 2. **European Communities, EU Marine Strategy: The story behind the strategy.,** 2006. http://ec.europa.eu/environment/marine/pdf/eumarinestrategy_storybook.pdf. 3. D. **Peel,** M.G. **Lloyd, The social reconstruction of the marine environment: Towards marine spatial planning?**, Town Plan. Rev. 75 (2004) 359–378. doi:10.3828/tpr.75.3.6.
C. **White,** B.S. **Halpern,** C. V. **Kappel, Ecosystem service tradeoff analysis reveals the value of marine spatial planning for multiple ocean uses,** Proc. Natl. Acad. Sci. U. S. A. 109 (2012) 4696–4701. doi:10.1073/pnas.1114215109.	1. K. **McLeod**, J. Lubchenco, S. Palumbi, A.A. Rosenberg, **Scientific Consensus Statement on Marine Ecosystem-Based Management,** (2005) 1–21. doi:10.1080/13880290109353975.
S. **Katsanevakis**, V. Stelzenmüller, A. South, T.K. Sørensen, P.J.S. Jones, S. Kerr, F. Badalamenti, C. Anagnostou, P. Breen, G. Chust, G. D'Anna, M. Duijn, T.	1. **Ehler, Conclusions: Benefits, lessons learned, and future challenges of marine spatial planning,** Mar. Policy. 32 (2008)

Filatova, F. Fiorentino, H. Hulsman, K. Johnson, A.P. Karageorgis, I. Kröncke, S. Mirto, C. Pipitone, S. Portelli, W. Qiu, H. Reiss, D. Sakellariou, M. Salomidi, L. van Hoof, V. Vassilopoulou, T. Vega Fernández, S. Vöge, A. Weber, A. Zenetos, R. ter Hofstede, **Ecosystem-based marine spatial management: Review of concepts, policies, tools, and critical issues,** Ocean Coast. Manag. 54 (2011) 807–820. doi:10.1016/j.ocecoaman.2011.09.002.	840–843. doi:10.1016/j.marpol. 2008.03.014. 2. B.S. **Halpern**, K.L. McLeod, A.A. Rosenberg, L.B. Crowder, **Managing for cumulative impacts in ecosystem-based management through ocean zoning,** Ocean Coast. Manag. 51 (2008) 203–211. doi:10.1016/j.ocecoaman.2007.08.002. 3. F. **Douvere, The importance of marine spatial planning in advancing ecosystem-based sea use management,** Mar. Policy. 32 (2008) 762–771. doi:10.1016/j.marpol.2008.03.021. 4. C.N. **Ehler,** F. **Douvere, Visions for a sea change, Report of the first international workshop on marine spatial planning,** UNESCO, Paris, 2007. 5. M.M. **Foley**, B.S. Halpern, F. Micheli, M.H. Armsby, M.R. Caldwell, C.M. Crain, E. Prahler, N. Rohr, D. Sivas, M.W. Beck, M.H. Carr, L.B. Crowder, J. Emmett Duffy, S.D. Hacker, K.L. McLeod, S.R. Palumbi, C.H. Peterson, H.M. Regan, M.H. Ruckelshaus, P.A. Sandifer, R.S. Steneck, **Guiding ecological principles for marine spatial planning**, Mar. Policy. 34 (2010) 955–966. doi:10.1016/j.marpol.2010.02.001. 6. **EC, Green Paper. Towards A Maritime Policy for the Union: A European vision for the oceans and seas, Communities.** II (2006).
P.M. **Gilliland**, D. **Laffoley, Key elements and steps in the process of developing ecosystem-based marine spatial planning**, 32 (2008) 787–796. doi:10.1016/j.marpol.2008.03.022.	No reference for own definition
J.D. **Allan,** P.B. McIntyre, S.D.P. Smith, B.S. Halpern, G.L. Boyer, A. Buchsbaum, G.A. Burton, L.M. Campbell, W.L. Chadderton, J.J.H. Ciborowski, P.J. Doran, T. Eder, D.M. Infante, L.B.	No explicit definition of MSP.

Johnson, C.A. Joseph, A.L. Marino, A. Prusevich, J.G. Read, J.B. Rose, E.S. Rutherford, S.P. Sowa, A.D. Steinman, **Joint analysis of stressors and ecosystem services to enhance restoration effectiveness,** Proc. Natl. Acad. Sci. U. S. A. 110 (2013) 372–377. doi:10.1073/pnas.1213841110.	
S.E. **Lester**, C. Costello, B.S. Halpern, S.D. Gaines, C. White, J.A. Barth, **Evaluating tradeoffs among ecosystem services to inform marine spatial planning,** Mar. Policy. 38 (2013) 80–89. doi:10.1016/j.marpol.2012.05.022.	1. C.N. **Ehler**, F. **Douvere, An international perspective on marine spatial planning initiatives,** Environments. 37 (2010) 9–20. 2. B.S. **Halpern**, J. Diamond, S. Gaines, S. Gelcich, M. Gleason, S. Jennings, S. Lester, A. Mace, L. McCook, K. McLeod, N. Napoli, K. Rawson, J. Rice, A. Rosenberg, M. Ruckelshaus, B. Saier, P. Sandifer, A. Scholz, A. Zivian, **Near-term priorities for the science, policy and practice of Coastal and Marine Spatial Planning (CMSP),** Mar. Policy. 36 (2012) 198–205. doi:10.1016/j.marpol.2011.05.004. 3. **F. Douvere,** F. Maes, A. Vanhulle, J. Schrijvers, **The role of marine spatial planning in sea use management: The Belgian case,** Mar. Policy. 31 (2007) 182–191. doi:10.1016/j.marpol.2006.07.003.
K. **St. Martin,** M. **Hall-Arber, The missing layer: Geo-technologies, communities, and implications for marine spatial planning,** Mar. Policy. 32 (2008) 779–786. doi:10.1016/j.marpol.2008.03.015.	No explicit definition of MSP
S.C. **Klain,** K.M.A. **Chan, Navigating coastal values: Participatory mapping of ecosystem services for spatial planning,** Ecol. Econ. 82 (2012) 104–113. doi:10.1016/j.ecolecon.2012.07.008.	1. C.N. **Ehler**, F. **Douvere, Marine Spatial Planning: A Step-by-Step Approach towards Ecosystem-based Management,** Paris, 2009. 2. M.M. **Foley**, B.S. Halpern, F. Micheli, M.H. Armsby, M.R. Caldwell, C.M. Crain, E. Prahler, N. Rohr, D. Sivas, M.W. Beck, M.H. Carr, L.B. Crowder, J. Emmett Duffy, S.D. Hacker, K.L. McLeod, S.R. Palumbi, C.H. Peterson, H.M. Regan, M.H. Ruckelshaus,

	P.A. Sandifer, R.S. Steneck, **Guiding ecological principles for marine spatial planning**, Mar. Policy. 34 (2010) 955–966. doi:10.1016/j.marpol.2010.02.001.
K.K. **Arkema**, G.M. Verutes, S.A. Wood, C. Clarke-samuels, S. Rosado, **Embedding ecosystem services in coastal planning leads to better outcomes for people and nature**, PNAS. 112 (2015) 7390–7395. doi:10.1073/pnas.1406483112.	No explicit definition of MSP.
F. Douvere, F. Maes, A. Vanhulle, J. Schrijvers, **The role of marine spatial planning in sea use management: The Belgian case,** Mar. Policy. 31 (2007) 182–191. doi:10.1016/j.marpol.2006.07.003.	1. **EC, Recommendation of the European Parliament and of the Council concerning the implementation of Integrated Coastal Zone Management in Europe** (2002/413/EC), Off. J. Eur. Communities. L 148 (2002) 24–27. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:148:0024:0027:EN:PDF.
W. **Wang,** H. Liu, Y. Li, J. Su, **Development and management of land reclamation in China**, Ocean Coast. Manag. 102 (2014) 415–425. doi:10.1016/j.ocecoaman.2014.03.009.	1. **Skimmer, Examining the Relationship between Marine Spatial Planning and EBM: Views from Three Planners**, Mar. Ecosyst. Manag. 3 (2010) 8.
H.M. **Murphy,** G.P. **Jenkins, Observational methods used in marine spatial monitoring of fishes and associated habitats: A review,** Mar. Freshw. Res. 61 (2010) 236–252. doi:10.1071/MF09068.	No explicit definition of MSP.
A.D. **Guerry,** M.H. Ruckelshaus, K.K. Arkema, J.R. Bernhardt, G. Guannel, C. Kim, M. Marsik, M. Papenfus, J.E. Toft, G. Verutes, S.A. Wood, M. Beck, K.M.A. Chan, G. Gelfenbaum, B.D. Gold, S. Benjamin, W.B. Labiosa, S.E. Lester, P.S. Levin, M.L. Pinsky, M. Plummer, S. Polasky, D.A. Sutherland, H. Tallis, A. Day, A.D. Guerry, M.H. Ruckelshaus, K.K. Arkema, J.R. Bernhardt, G. Guannel, C. Kim, M. Marsik, M. Papenfus, J.E. Toft, S.A. Wood, M. Beck,	1. **Center for Ocean Solutions**. Decision Guide, (2011) 52 pp. http://www.centerforoceansolutions.org/ 2. **The White House CEQ**, **Final Recommendations Of The Interagency Ocean Policy Task Force**, 2010. doi:10.1007/BF00780663. http://www.whitehouse.gov/administration/eop/oceans. 3. C.N. **Ehler**, F. **Douvere, Marine Spatial Planning: A Step-by-Step Approach**

F. Chan, K.M.A. Chan, G. Gelfenbaum, B.D. Gold, B.S. Halpern, W.B. Labiosa, S.E. Lester, P.S. Levin, M. Mcfield, M.L. Pinsky, M. Plummer, S. Polasky, P. Ruggiero, A. Sutherland, H. Tallis, A. Day, J. Spencer, **Modeling benefits from nature: using ecosystem services to inform coastal and marine spatial planning,** Int. J. Biodivers. Sci. Ecosyst. Serv. Manag. 3732 (2012) 2151–3740. doi:10.1080/21513732.2011.647835.	**towards Ecosystem-based Management,** Paris, 2009. 4. M.M. **Foley**, B.S. Halpern, F. Micheli, M.H. Armsby, M.R. Caldwell, C.M. Crain, E. Prahler, N. Rohr, D. Sivas, M.W. Beck, M.H. Carr, L.B. Crowder, J. Emmett Duffy, S.D. Hacker, K.L. McLeod, S.R. Palumbi, C.H. Peterson, H.M. Regan, M.H. Ruckelshaus, P.A. Sandifer, R.S. Steneck, **Guiding ecological principles for marine spatial planning**, Mar. Policy. 34 (2010) 955–966. doi:10.1016/j.marpol.2010.02.001.
R. **Lewison,** A.J. Hobday, S. Maxwell, E. Hazen, J.R. Hartog, D.C. Dunn, D. Briscoe, S. Fossette, C.E. O'Keefe, M. Barnes, M. Abecassis, S. Bograd, N.D. Bethoney, H. Bailey, D. Wiley, S. Andrews, L. Hazen, L.B. Crowder, **Dynamic ocean management: Identifying the critical ingredients of dynamic approaches to ocean resource management,** Bioscience. 65 (2015) 486–498. doi:10.1093/biosci/biv018.	No explicit definition of MSP
J. **Day, The need and practice of monitoring, evaluating and adapting marine planning and management-lessons from the Great Barrier Reef,** Mar. Policy. 32 (2008) 823–831. doi:10.1016/j.marpol.2008.03.023.	No explicit definition of MSP
N.C. **Ban,** H.M. **Alidina,** J.A**. Ardron, Cumulative impact mapping: Advances, relevance and limitations to marine management and conservation, using Canada's Pacific waters as a case study,** Mar. Policy. 34 (2010) 876–886. doi:10.1016/j.marpol.2010.01.010.	No explicit definition of MSP
B.S. **Halpern,** C.J. Klein, C.J. Brown, M. Beger, H.S. Grantham, S. Mangubhai, M. Ruckelshaus, V.J. Tulloch, M. Watts, C. White, H.P. Possingham, **Achieving the**	No explicit definition of MSP

triple bottom line in the face of inherent trade-offs among social equity, economic return, and conservation, Proc. Natl. Acad. Sci. U. S. A. 110 (2013) 6229–6234. doi:10.1073/pnas.1217689110.	
S.J. **Pittman**, B.M. **Costa**, T.A. **Battista, Using lidar bathymetry and boosted regression trees to predict the diversity and abundance of fish and corals,** J. Coast. Res. (2009) 27–38. doi:10.2112/SI53-004.1.	No explicit definition of MSP
S.J. **Pittman,** K.A. **Brown, Multi-scale approach for predicting fish species distributions across coral reef seascapes,** PLoS One. 6 (2011). doi:10.1371/journal.pone.0020583.	No explicit definition of MSP
W**. Qiu,** P.J.S. **Jones, The emerging policy landscape for marine spatial planning in Europe,** Mar. Policy. 39 (2013) 182–190. doi:10.1016/j.marpol.2012.10.010.	1. C.N. **Ehler,** F. **Douvere, Visions for a sea change, Report of the first international workshop on marine spatial planning,** UNESCO, Paris, 2007. 2. F. **Douvere, The importance of marine spatial planning in advancing ecosystem-based sea use management,** Mar. Policy. 32 (2008) 762–771. doi:10.1016/j.marpol.2008.03.021. 3. F. **Maes, The international legal framework for marine spatial planning,** Mar. Policy. 32 (2008) 797–810. doi:10.1016/j.marpol.2008.03.013.
E. **Mckenzie,** S. Posner, P. Tillmann, J.R. Bernhardt, K. Howard, A. Rosenthal, **Understanding the use of ecosystem service knowledge in decision making: Lessons from international experiences of spatial planning,** Environ. Plan. C Gov. Policy. 32 (2014) 320–340. doi:10.1068/c12292j.	No explicit definition of MSP
P.D. **Eastwood,** C.M. Mills, J.N. Aldridge, C.A. Houghton, S.I. Rogers**, Human activities in UK offshore**	1. T. **Blundell, Turning the Tide: Addressing the Impact of Fisheries on the Marine Environment,** R. Comm.

waters: An assessment of direct, physical pressure on the seabed, ICES J. Mar. Sci. 64 (2007) 453–463. doi:10.1093/icesjms/fsm001.	Environ. Pollution. Parlamient UK. (2004) 497. http://www.gov.scot/Publications/ 2006/06/ 05151958/0. 2. D. **Tyldesley, A vision for marine spatial planning,** in: ECOS, 2006: pp. 33–39.
M. **Gopnik,** C. Fieseler, L. Cantral, K. McClellan, L. Pendleton, L. Crowder, **Coming to the table: Early stakeholder engagement in marine spatial planning,** Mar. Policy. 36 (2012) 1139–1149. doi:10.1016/j.marpol.2012.02.012.	1. C.N. **Ehler**, F. **Douvere, Marine Spatial Planning: A Step-by-Step Approach towards Ecosystem-based Management,** Paris, 2009. 2. **The White House, Executive Order 13547. Stewardship of the Ocean, Our Coasts, and the Great Lakes |** whitehouse.gov, (2010). https://obamawhitehouse.archives.gov/ the-press- office/executive-order-stewardship-ocean-our-coasts-and-great-lakes (accessed August 31, 2020).
H. **Backer**, J.M. Leppänen, A.C. Brusendorff, K. Forsius, M. Stankiewicz, J. Mehtonen, M. Pyhälä, M. Laamanen, H. Paulomäki, N. Vlasov, T. Haaranen, **HELCOM Baltic Sea Action Plan - A regional programme of measures for the marine environment based on the Ecosystem Approach,** Mar. Pollut. Bull. 60 (2010) 642–649. doi:10.1016/j.marpolbul.2009.11.016.	1. F. **Douvere,** C. **Ehler, Introduction,** Mar. Policy. 32 (2008) 759–761. doi:10.1016/j.marpol.2008.03.019.
J. **Ardron**, K. **Gjerde**, S. **Pullen, V. Tilot, Marine spatial planning in the high seas,** Mar. Policy. 32 (2008) 832–839. doi:10.1016/j.marpol.2008.03.018.	1. C.N. **Ehler,** F. **Douvere, Visions for a sea change, Report of the first international workshop on marine spatial planning,** UNESCO, Paris, 2007.
M.J. **Bishop**, M. Mayer-Pinto, L. Airoldi, L.B. Firth, R.L. Morris, L.H.L. Loke, S.J. Hawkins, L.A. Naylor, R.A. Coleman, S.Y. Chee, K.A. Dafforn, **Effects of ocean sprawl on ecological connectivity: impacts and solutions,**	No explicit definition of MSP

J. Exp. Mar. Bio. Ecol. 492 (2017) 7–30. doi:10.1016/j.jembe.2017.01.021.	
B.S. **Halpern,** R. **Fujita, Assumptions, challenges, and future directions in cumulative impact analysis,** Ecosphere. 4 (2013) 1–11. doi:10.1890/ES13-00181.1.	1. B.S. **Halpern**, K.L. McLeod, A.A. Rosenberg, L.B. Crowder, **Managing for cumulative impacts in ecosystem-based management through ocean zoning,** Ocean Coast. Manag. 51 (2008) 203–211. doi:10.1016/j.ocecoaman.2007.08.002. 2. K. **McLeod,** H. **Leslie, Ecosystem-based Mangement for the Oceans**, Island Press, 2009.
F. **Maes, The international legal framework for marine spatial planning,** Mar. Policy. 32 (2008) 797–810. doi:10.1016/j.marpol.2008.03.013.	1. C.N. **Ehler,** F. **Douvere, Visions for a sea change, Report of the first international workshop on marine spatial planning,** UNESCO, Paris, 2007.
P.J.S. **Jones,** L.M. **Lieberknecht,** W. **Qiu, Marine spatial planning in reality: Introduction to case studies and discussion of findings**, Mar. Policy. 71 (2016) 256–264. doi:10.1016/j.marpol.2016.04.026.	1. C.N. **Ehler**, F. **Douvere, Marine Spatial Planning: A Step-by-Step Approach towards Ecosystem-based Management,** Paris, 2009.
N.T. **Hintzen**, F. Bastardie, D. Beare, G.J. Piet, C. Ulrich, N. Deporte, J. Egekvist, H. Degel**, VMStools: Open-source software for the processing, analysis and visualisation of fisheries logbook and VMS data,** Fish. Res. 115–116 (2012) 31–43. doi:10.1016/j.fishres.2011.11.007.	1. F. **Douvere,** C.N. **Ehler, New perspectives on sea use management: Initial findings from European experience with marine spatial planning,** J. Environ. Manage. 90 (2009) 77–88. doi:10.1016/j.jenvman.2008.07.004.
B.S. **Halpern,** J. Diamond, S. Gaines, S. Gelcich, M. Gleason, S. Jennings, S. Lester, A. Mace, L. McCook, K. McLeod, N. Napoli, K. Rawson, J. Rice, A. Rosenberg, M. Ruckelshaus, B. Saier, P. Sandifer, A. Scholz, A. Zivian, **Near-term priorities for the science, policy and practice of Coastal and Marine Spatial Planning (CMSP),** Mar. Policy. 36 (2012) 198–205. doi:10.1016/j.marpol.2011.05.004.	1. **The White House, Executive Order 13547. Stewardship of the Ocean, Our Coasts, and the Great Lakes |** whitehouse.gov, (2010). https://obamawhitehouse.archives.gov/ the-press- office/executive-order-stewardship-ocean-our-coasts-and-great-lakes (accessed August 31, 2020).

A. **Böhnke-Henrichs,** C. Baulcomb, R. Koss, S.S. Hussain, R.S. de Groot, **Typology and indicators of ecosystem services for marine spatial planning and management,** J. Environ. Manage. 130 (2013) 135–145. doi:10.1016/j.jenvman.2013.08.027.	No explicit definition of MSP
J. V. **Redfern,** M.F. McKenna, T.J. Moore, J. Calambokidis, M.L. Deangelis, E.A. Becker, J. Barlow, K.A. Forney, P.C. Fiedler, S.J. Chivers, **Assessing the Risk of Ships Striking Large Whales in Marine Spatial Planning**, Conserv. Biol. 27 (2013) 292–302. doi:10.1111/cobi.12029.	1. L.B. **Crowder**, G. Osherenko, O.R. Young, S. Airamé, E.A. Norse, N. Baron, J.C. Day, F. Douvere, C.N. Ehler, B.S. Halpern, S.J. Langdon, K.L. McLeod, J.C. Ogden, R.E. Peach, A.A. Rosenberg, J.A. Wilson, **Resolving Mismatches in U.S. Ocean Governance,** Science (80-.). 313 (2006) 617–618. doi:10.32388/pglqg4.
J.S. **Collie,** W.L. Vic Adamowicz, M.W. Beck, B. Craig, T.E. Essington, D. Fluharty, J. Rice, J.N. Sanchirico, **Marine spatial planning in practice,** Estuar. Coast. Shelf Sci. 117 (2013) 1–11. doi:10.1016/j.ecss.2012.11.010.	1. C.N. **Ehler**, F. **Douvere, Marine Spatial Planning: A Step-by-Step Approach towards Ecosystem-based Management,** Paris, 2009. 2. B.S. **Halpern**, J. Diamond, S. Gaines, S. Gelcich, M. Gleason, S. Jennings, S. Lester, A. Mace, L. McCook, K. McLeod, N. Napoli, K. Rawson, J. Rice, A. Rosenberg, M. Ruckelshaus, B. Saier, P. Sandifer, A. Scholz, A. Zivian, **Near-term priorities for the science, policy and practice of Coastal and Marine Spatial Planning (CMSP),** Mar. Policy. 36 (2012) 198–205. doi:10.1016/j.marpol.2011.05.004.
L.T. **Hatch**, C.W. Clark, S.M. Van Parijs, A.S. Frankel, D.W. Ponirakis, **Quantifying Loss of Acoustic Communication Space for Right Whales in and around a U.S. National Marine Sanctuary,** Conserv. Biol. 26 (2012) 983–994. doi:10.1111/j.1523-1739.2012.01908.x.	No explicit definition of MSP.
K.L. **Scales**, P.I. Miller, L.A. Hawkes, S.N. Ingram, D.W. Sims, S.C. Votier, **On the front line: Frontal zones as priority at-sea conservation areas for mobile marine vertebrates,** J. Appl.	No explicit definition of MSP.

Ecol. 51 (2014) 1575–1583. doi:10.1111/1365-2664.12330.	
R.J. **Toonen**, T.A. Wilhelm, S.M. Maxwell, D. Wagner, B.W. Bowen, C.R.C. Sheppard, S.M. Taei, T. Teroroko, R. Moffitt, C.F. Gaymer, L. Morgan, N. Lewis, A.L.S. Sheppard, J. Parks, A.M. Friedlander, **One size does not fit all: The emerging frontier in large-scale marine conservation,** Mar. Pollut. Bull. 77 (2013) 7–10. doi:10.1016/j.marpolbul.2013.10.039.	No explicit definition of MSP.
C. **Ehler, Conclusions: Benefits, lessons learned, and future challenges of marine spatial planning,** Mar. Policy. 32 (2008) 840–843. doi:10.1016/j.marpol.2008.03.014.	No reference for own definition.
B.G. **Lascelles**, P.R. Taylor, M.G.R. Miller, M.P. Dias, S. Oppel, L. Torres, A. Hedd, M. Le Corre, R.A. Phillips, S.A. Shaffer, H. Weimerskirch, C. Small, **Applying global criteria to tracking data to define important areas for marine conservation,** Divers. Distrib. 22 (2016) 422–431. doi:10.1111/ddi.12411.	No explicit definition of MSP
B.G. **Lascelles**, G.M. Langham, R.A. Ronconi, J.B. Reid, **From hotspots to site protection: Identifying Marine Protected Areas for seabirds around the globe,** Biol. Conserv. 156 (2012) 5–14. doi:10.1016/j.biocon.2011.12.008.	1. T. **Agardy,** G.N. **di Sciara,** P. **Christie, Mind the gap: Addressing the shortcomings of marine protected areas through large scale marine spatial planning,** Mar. Policy. 35 (2011) 226–232. doi:10.1016/j.marpol.2010.10.006. 2. C.N. **Ehler**, F. **Douvere, Marine Spatial Planning: A Step-by-Step Approach towards Ecosystem-based Management,** Paris, 2009. 3. P.M. **Gilliland,** D. **Laffoley, Key elements and steps in the process of developing ecosystem-based marine spatial planning,** 32 (2008) 787–796. doi:10.1016/j.marpol.2008.03.022.

D.C. **Dunn**, J. Ardron, N. Bax, P. Bernal, J. Cleary, I. Cresswell, B. Donnelly, P. Dunstan, K. Gjerde, D. Johnson, K. Kaschner, B. Lascelles, J. Rice, H. Von Nordheim, L. Wood, P.N. Halpin, **The Convention on Biological Diversity's Ecologically or Biologically Significant Areas: Origins, development, and current status**, Mar. Policy. 49 (2014) 137–145. doi:10.1016/j.marpol.2013.12.002.	No reference for own definition.

Supplementary Material B. List of the 30 'defining' documents on MSP, including the number of times they are cited in the 50-documents list, the main MSP definition they use, and the human activities they address.

Reference	MSP definition/purpose	Human uses/activities mentioned
C.N. **Ehler**, F. **Douvere, Marine Spatial Planning: A Step-by-Step Approach towards Ecosystem-based Management,** Paris, 2009. Cited by 7/50 documents	Marine spatial planning (MSP) is a practical way to create and establish a more rational organization of the use of marine space and the interactions between its uses, to balance demands for development with the need to protect marine ecosystems, and to achieve social and economic objectives in an open and planned way.(source) Marine spatial planning (MSP) is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process. It is important to remember that we can only plan and manage human activities in marine areas, not marine ecosystems or components of ecosystems. We can allocate human activities to specific marine areas by objective, e.g., development or preservation areas, or by specific	Fishing (Commercial and Recreational) Renewable energy Oil and gas mining Military defence Maritime transport Aquaculture

	uses, e.g., wind farms, offshore aquaculture, or sand and gravel mining. Characteristics of effective marine spatial planning: Ecosystem-based, balancing ecological, economic, and social goals and objectives toward sustainable development; Integrated, across sectors and agencies, and among levels of government; Place-based or area-based; Adaptive, capable of learning from experience; Strategic and anticipatory, focused on the long-term; Participatory, stakeholders actively involved in the process.	
C.N. **Ehler,** F. **Douvere, Visions for a sea change, Report of the first international workshop on marine spatial planning,** UNESCO, Paris, 2007. Cited by 7/50 documents	Marine spatial planning is a way of improving decision making and delivering an ecosystem-based approach to managing human activities in the marine environment. It is a planning process that enables integrated, forward looking, and consistent decision making on the human uses of the sea. Marine spatial planning is analogous to spatial or land use planning in terrestrial environments. Ecosystem-based, marine spatial planning seeks to sustain the benefits of the ecological goods and services that the oceans provide to humans as well as all living organisms on the planet. A process of analyzing and allocating parts of three-dimensional marine spaces to specific uses, to achieve ecological, economic, and social objectives that are usually specified through the political process; the MSP process usually results in a comprehensive plan or vision for a marine region. MSP is an element of sea use management.	Fishing (Commercial and recreational) Aquaculture Shipping Oil & Gas activities Renewable Energy (e.g., wind, waves) Sand and Gravel Mining Dredging Dredged Material Disposal Recreation and Tourism Airports Pipelines Cables Transmission Lines Bio-prospecting Desalinization Military Activities Scientific Research Marine Protected Areas Cultural and historic conservation (e.g., ship wrecks)
M.M. **Foley**, B.S. Halpern, F. Micheli, M.H. Armsby, M.R. Caldwell, C.M. Crain, E.	One proposed solution to this problem is ecosystem-based marine spatial planning (MSP), which is a process that informs the spatial	Fishing Aquaculture Shipping Cultural uses

Prahler, N. Rohr, D. Sivas, M.W. Beck, M.H. Carr, L.B. Crowder, J. Emmett Duffy, S.D. Hacker, K.L. McLeod, S.R. Palumbi, C.H. Peterson, H.M. Regan, M.H. Ruckelshaus, P.A. Sandifer, R.S. Steneck, **Guiding ecological principles for marine spatial planning**, Mar. Policy. 34 (2010) 955–966. doi:10.1016/j.marpol.2010.02.001. Cited by 4/50 documents	distribution of activities in the ocean so that existing and emerging uses can be maintained, use conflicts reduced, and ecosystem health and services protected and sustained for future generations. Because a key goal of ecosystem-based MSP is to maintain the delivery of ecosystem services that humans want and need (1) Ecosystem-based MSP is an integrated planning framework that informs the spatial distribution of activities in and on the ocean in order to support current and future uses of ocean ecosystems and maintain the delivery of valuable ecosystem services for future generations in a way that meets ecological, economic, and social objectives (2) In addition, this integrated planning process moves away from sectoral management by assessing and managing for the cumulative effects of multiple activities within a specific area (3) An MSP process also emphasizes the legal, social, economic, and ecological complexities of governance, including the designation of authority, stakeholder participation, financial support, analysis of current and future uses and ocean condition, enforcement, monitoring, and adaptive management MSP has emerged as a framework for implementing an ecosystem-based, coordinated governance structure in the world's oceans. The ultimate goal of ecosystem-based MSP is to distribute human uses in the ocean in a way that allows for existing and emerging cultural, recreational, commercial, and industrial uses, while supporting	Recreational activities Commercial activities Industrial activities Renewable energy (e.g. wind) Marine Protected Areas

	healthy ecosystems and sustaining the provision of ecosystem services for current and future generations.	
F. **Douvere, The importance of marine spatial planning in advancing ecosystem-based sea use management,** Mar. Policy. 32 (2008) 762–771. doi:10.1016/j.marpol.2008.03.021. Cited by 3/50 documents	Addresses the heterogeneity of marine ecosystems in a practical manner. MSP takes into account that some things only occur in certain places. Important ecological areas, for example, are located in areas of high diversity, endemism or productivity, spawning and nursery areas, and migration stopover points [42]. At the same time, economic activity will (and can) only take place where the resources are located, as for example, oil and gas deposits, sand and gravel deposits, and areas of sustained winds or waves. Focuses on influencing the behavior of humans and their activities over time. Although goals and objectives for a certain area are usually set for both ecosystem/natural processes and human activities, it is only the human component (human activities and resource use) that can be managed (not the ecosystem itself), e.g., through management measures (incentives) that change behavior of humans and their activities over time. Provides a management framework for new and previously inaccessible scientific information. Through remote sensing, tracking technologies, and global positioning technologies, science is making visible what had previously been hidden or inaccessible and increases the need for a management framework that allows the effective integration and use of new scientific information in decision-making processes. Makes conflicts and compatibilities among human uses visible, and therefore tangible. Through the mapping of ecosystems, their characteristics, and human activities affecting it one can see	Fishing Aquaculture Shipping Oil and gas development Renewable energy (e.g. wind) Mining Marine Protected Areas Conservation

	where conflicts are or will be located. Guides single-sector management toward integrative decisionmaking. The development of marine spatial plans for an entire region visualizes alternative scenarios (drawn from a specified set of sectoral objectives) for ecosystem-based management, which in turn can provide guidance to a range of decisionmakers, each responsible for only a particular sector or activity of the entire area (e.g., fisheries managers will see what conflicts and compatibilities their management plans will have with plans for the offshore development of wind farms). (1) Create and establish a more rational organization of the use of marine space and the interactions between its uses, to balance demands for development with the need to protect the environment, and to achieve social and economic objectives in an open and planned way. (2) Analyzing and allocating parts of three-dimensional marine spaces to specific uses, to achieve ecological, economic, and social objectives that are usually specified through the political process. MSP aims to provide a mechanism for a strategic and integrated plan-based approach for marine management that makes it possible to look at the ''bigger picture'' and to manage current and potential conflicting uses, the cumulative effects of human activities, and marine protection.	
The White House, Executive Order 13547. Stewardship of the Ocean, Our Coasts, and the Great Lakes | whitehouse.gov,	The term "coastal and marine spatial planning" means a comprehensive, adaptive, integrated, ecosystem-based, and transparent spatial planning process, based on sound science, for analyzing current and anticipated uses of ocean, coastal,	Conservation

(2010). https://obamawhitehouse.archives.gov/the-press-office/executive-order-stewardship-ocean-our-coasts-and-great-lakes (accessed August 31, 2020). Cited by 2/50 coded documents	and Great Lakes areas. Coastal and marine spatial planning identifies areas most suitable for various types or classes of activities in order to reduce conflicts among uses, reduce environmental impacts, facilitate compatible uses, and preserve critical ecosystem services to meet economic, environmental, security, and social objectives. In practical terms, coastal and marine spatial planning provides a public policy process for society to better determine how the ocean, our coasts, and Great Lakes are sustainably used and protected -- now and for future generations.	
B.S. **Halpern**, J. Diamond, S. Gaines, S. Gelcich, M. Gleason, S. Jennings, S. Lester, A. Mace, L. McCook, K. McLeod, N. Napoli, K. Rawson, J. Rice, A. Rosenberg, M. Ruckelshaus, B. Saier, P. Sandifer, A. Scholz, A. Zivian, **Near-term priorities for the science, policy and practice of Coastal and Marine Spatial Planning (CMSP),** Mar. Policy. 36 (2012) 198–205. doi:10.1016/j.marpol.2011.05.004. Cited by 2/50 coded documents	1) As defined in Obama's Executive Order, CMSP is a comprehensive, adaptive, integrated, ecosystem-based, and transparent spatial planning process for analysing current and anticipated uses of ocean and coastal areas. The process involves identifying areas most suitable for various types of activities in order to reduce conflicts among uses, reduce environmental impacts, facilitate compatible uses, and preserve critical ecosystem services to meet economic, environmental, security, and social objectives	Fishing Oil and gas extraction Shipping (and transport) Military activities mining Recreation Conservation Aquaculture Ocean energy
B.S. **Halpern**, K.L. McLeod, A.A. Rosenberg, L.B. Crowder, **Managing for cumulative impacts in ecosystem-based management through ocean zoning,** Ocean Coast. Manag. 51 (2008)	Marine spatial planning, and its key component comprehensive ocean zoning, is well-equipped to account for these differential impacts of stressors by isolating the dominant stressors into unique areas while allowing multiple weak stressors to co-occur.	Fishing Coastal development Water management Energy production Aquaculture Shipping

203–211. doi:10.1016/j.ocecoaman.2007.08.002. Cited by 2/50 coded documents		
L. **Crowder,** E. **Norse, Essential ecological insights for marine ecosystem-based management and marine spatial planning,** Mar. Policy. 32 (2008) 772–778. doi:10.1016/j.marpol.2008.03.012. Cited by 2/50 coded documents	Including marine reserves in comprehensive marine spatial plans can protect vulnerable animals from damaging human activities, such as fisheries.	Fishing Military activities Recreational boating Scuba diving Aquaculture Oil and gas development, Shipping
F. **Douvere,** C.N. **Ehler, New perspectives on sea use management: Initial findings from European experience with marine spatial planning,** J. Environ. Manage. 90 (2009) 77–88. doi:10.1016/j.jenvman.2008.07.004. Cited by 1/50 coded documents	1. In its broadest sense, marine spatial planning can be defined as: Analyzing and allocating parts of three-dimensional marine spaces to specific uses or non-use, to achieve ecological, economic, and social objectives that are usually specified through a political process. Marine spatial planning is a sub-activity of the overall planning activity of sea use management. Despite the different contexts, the process for developing marine spatial planning is similar to land use planning in the terrestrial environment. The principal output of marine spatial planning is a comprehensive marine spatial plan or alternatively ‘‘comprehensive development plan’’ or ‘‘comprehensive master plan’’. It is a ‘‘vision’’ of the future of the marine region or ecosystem and reflects the output of a process in which stakeholders collectively define their purpose, core values, and perspective for the future. The vision declares common goals, guides regional decision-making, unites stakeholders with a common purpose, and motivates citizens and decision-makers to meet the goals of the	Fishing Shipping Aquaculture Pipelines and cables Off shore activities (oil and gas, marine aggregates) Wind farms Dredging

	vision. The comprehensive marine spatial plan is usually long-term, general in nature and policy oriented and is implemented through more detailed zoning maps, zoning regulations and a permit system. Individual permit or licensing decisions can then be made based on the zoning maps, that in turn reflect the vision of the comprehensive marine spatial plan marine spatial planning can only influence the spatial and temporal distribution of human activities. Other measures that can influence the inputs to human activities (e.g., limitations on fishing activity and capacity), the processes of human activities (e.g., requirement for ''best environmental practice''), or the outputs of human activities (e.g., tonnage limitations on mineral extraction), need to be taken in conjunction with the spatial planning measures. Marine spatial planning is seen as a key aspect to managing a growing and increasingly competing maritime economy, while at the same time safeguarding biodiversity. (2) It describes marine spatial planning as a means to (European Commission, 2006): Coordinate the spatial implementation of off-shore renewable energy with other activities; Provide financial security for investment decisions; Advocate marine spatial planning as a tool to enable the management of increasing, and often conflicting, uses of the oceans; Manage the competition among various uses (including their multiple objectives) in the marine environment;	

	Develop a stable regulatory environment that ensures better and simpler regulation toward the location of economic activity; Ensure that individual decision on activities, taken at a national or regional level, but affecting the same ecosystem or cross-border activities (for example, pipelines and shipping routes) are dealt with in a coherent manner; (3) Marine spatial planning, compared to land use planning, is a fairly new and emerging area (Peel and Lloyd, 2004)	
F. **Douvere**, F. Maes, A. Vanhulle, J. Schrijvers, **The role of marine spatial planning in sea use management: The Belgian case,** Mar. Policy. 31 (2007) 182–191. doi:10.1016/j.marpol.2006.07.003. Cited by 1/50 coded documents	The EU recommendations on ICZM (2002) identify MSP as a key ingredient in achieving integrated management of the coastal area and its resources	Fishing Offshore activities Tourism Shipping Sand and gravel exploitation Conservation Aquaculture Wind farms
C.N. **Ehler**, F. **Douvere, An international perspective on marine spatial planning initiatives,** Environments. 37 (2010) 9–20. Cited by 1/50 coded documents	Marine spatial planning (MSP) is the public process of analysing and allocating the spatial distribution of human activities in marine areas to achieve ecological, economic and social objectives that are usually specified through a political process (Ehler and Douvere 2006).	Fishing Shipping (and transport) Hydrocarbon activities (e.g. oil and gas development) Marine Protected Areas Aquaculture Sand extraction
Skimmer, Examining the Relationship between Marine Spatial Planning and EBM: Views from Three Planners, Mar. Ecosyst. Manag. 3 (2010) 8.	Little or no MSP Example: A minor degree of spatial planning is in place, perhaps in the form of a small marine protected area or a port. But there is no systematic effort to plan the use of the marine environment, balancing trade-offs among a range of sectors and needs.	Shipping Petroleum activities (e.g. oil drilling) Offshore wind energy Nature protection Fishing Defence

Cited by 1/50 coded documents	Incremental MSP Example: This could be a spatial plan that addresses offshore energy production and shipping lanes but does not yet cover other existing uses, such as commercial fishing. Incidentally, this is the case for the Massachusetts Ocean Management Plan and Norway's Barents Sea Plan. Although management in these cases has not addressed all uses, spatial trade-offs between two or more sectors have been considered and MSP is being practiced. Comprehensive MSP Example: In this case, the spatial plan addresses all uses of the marine environment in a particular area, including potential future uses and conditions	Tourism
F. **Maes, The international legal framework for marine spatial planning,** Mar. Policy. 32 (2008) 797–810. doi:10.1016/j.marpol.2008.03.013. Cited by 1/50 coded documents	Marine spatial planning (MSP) can be used as an appropriate process and instrument to avoid user conflicts, to manage marine activities more sustainably and to implement improved area-based protection and conservation of marine living resources. (1) MSP can be defined as ‘‘a process of analyzing and allocating parts of the three-dimensional marine spaces to specific uses, to achieve ecological, economic and social objectives that are usually specified through the political process; the MSP process usually results in a comprehensive plan or vision for a marine region’’ [5]. MSP is a complicated, but necessary process, to establish a more rational organization of using marine space and the user interactions in order to protect the biological diversity of the marine environment, while taking into account social and economic objectives. A product of MSP can be a strategic plan that looks forward and	Fishing Shipping Air transport Military use Water recreation Sand and gravel extraction Dredging activities Conservation MPAs

	is proactive to regulate, manage and protect the marine environment by allocating space to resolve actual and potential multiple conflicting uses and to facilitate sustainable management of the seas.	
Center for Ocean Solutions. Decision Guide, (2011) 52 pp. http://www.centerforoceansolutions.org/ Cited by 1/50 coded documents	In this Decision Guide, the term marine spatial planning is used, but emphasis is placed on the systematic and spatial nature of these approaches rather than the name itself. The systematic component provides a framework for more comprehensive, flexible, well-governed, and science-based planning processes, while the spatial component adds a place-based focus to planning processes. The goals of these approaches are to promote efficient use of marine space and resources, while reducing use-use and use-ecosystem conflicts.	Fishing Renewable energy (e.g. wind) Shipping Conservation Aquaculture
The White House CEQ, **Final Recommendations Of The Interagency Ocean Policy Task Force**, 2010. doi:10.1007/BF00780663.http://www.whitehouse.gov/administration/eop/oceans. Cited by 1/50 coded documents	CMSP is a comprehensive, adaptive, integrated, ecosystem-based, and transparent spatial planning process, based on sound science, for analyzing current and anticipated uses of ocean, coastal, and Great Lakes areas. CMSP identifies areas most suitable for various types or classes of activities in order to reduce conflicts among uses, reduce environmental impacts, facilitate compatible uses, and preserve critical ecosystem services to meet economic, environmental, security, and social objectives. In practical terms, CMSP provides a public policy process for society to better determine how the ocean, coasts, and Great Lakes are sustainably used and protected - now and for future generations. CMSP provides an effective process to better manage a range of social, economic, and cultural uses, including:	Fishing (commercial and recreational) Aquaculture (fish, shellfish, and seaweed farming) Commerce and Transportation (e.g., cargo and cruise ships, tankers, and ferries) Environmental/Conservation (e.g., marine sanctuaries, reserves, national parks, and wildlife refuges) Maritime Heritage and Archeology Mining (e.g., sand and gravel) Oil and Gas Exploration and Development Ports and Harbors

	• Aquaculture (fish, shellfish, and seaweed farming) • Commerce and Transportation (e.g., cargo and cruise ships, tankers, and ferries) • Commercial Fishing • Environmental/Conservation (e.g., marine sanctuaries, reserves, national parks, and wildlife refuges) • Maritime Heritage and Archeology • Mining (e.g., sand and gravel) • Oil and Gas Exploration and Development • Ports and Harbors • Recreational Fishing • Renewable Energy (e.g., wind, wave, tidal, current, and thermal) • Other Recreation (e.g., boating, beach access, swimming, surfing, nature and whale watching, and diving) • Scientific Research and Exploration • Security, Emergency Response, and Military Readiness Activities • Subsistence Uses • Tourism • Traditional Hunting, Fishing, and Gathering • Working Waterfronts CMSP can facilitate sustainable economic growth	Renewable Energy (e.g., wind, wave, tidal, current, and thermal) Other Recreation (e.g., boating, beach access, swimming, surfing, nature and whale watching, and diving) Scientific Research and Exploration Security, Emergency Response, and Military Readiness Activities Subsistence Uses Tourism Traditional Hunting, Fishing, and Gathering Working Waterfronts
C. **Ehler, Conclusions: Benefits, lessons learned, and future challenges of marine spatial planning,** Mar. Policy. 32 (2008) 840–843. doi:10.1016/j.marpol.2008.03.014. Cited by 1/50 coded documents	MSP is an important function of ecosystem-based sea use management. MSP can be used to identify biologically and ecologically sensitive areas of marine places in time and space, to identify existing and potential human uses of marine places, and to evaluate the cumulative effects of human activities on marine ecosystems. It can be used to influence the location in space and time of human activities and therefore encourage compatible uses, reduce conflicts among uses, and reduce conflicts between human uses	Shipping Ports Fishing Dredging

	and the environment (see the article of Gilliland and Laffoley in this issue).	
DEFRA. **A sea change**. A Marine Bill White Paper. In: Presented to parliament by the secretary of state for environment, food and rural affairs by command of Her Majesty. London, March 2007. Cited by 1/50 coded documents	Marine Spatial Planning Proposed system for strategically managing activities in the marine area.	Fishing Cultural marine heritage
L.B. **Crowder**, G. Osherenko, O.R. Young, S. Airamé, E.A. Norse, N. Baron, J.C. Day, F. Douvere, C.N. Ehler, B.S. Halpern, S.J. Langdon, K.L. McLeod, J.C. Ogden, R.E. Peach, A.A. Rosenberg, J.A. Wilson, **Resolving Mismatches in U.S. Ocean Governance,** Science (80-.). 313 (2006) 617–618. doi:10.32388/pglqg4. Cited by 1/50 coded documents	No explicit definition of MSP.	Fishing Aquaculture Oil and gas extraction Shipping Conservation Mining Wind farms
T. **Agardy,** G.N. **di Sciara,** P. **Christie, Mind the gap: Addressing the shortcomings of marine protected areas through large scale marine spatial planning,** Mar. Policy. 35 (2011) 226–232. doi:10.1016/j.marpol.2010.10.006. Cited by 1/50 coded documents	Marine spatial plans that utilize existing information on key areas needing protection, support sustainable development and management of marine resources overall, and are both adaptive and tailor management to existing resource use could set in motion much more effective and efficient management regimes than what we have seen to date.	Fishing (Commercial and recreational) Aquaculture Marine Protected Areas Conservation
P.M. **Gilliland,** D. **Laffoley, Key elements and steps in the process of developing**	Marine spatial planning (MSP) is an essential tool for delivering an Ecosystem Approach MSP by definition involves some kind of forward look. It includes	Shipping Marine Protected Areas Infrastructure Fishing

ecosystem-based marine spatial planning, 32 (2008) 787–796. doi:10.1016/j.marpol.2008.03.022. Cited by 1/50 coded documents	expressing a vision about what is desired in the future, The nature of MSP is such that stakeholder engagement should be considered intrinsic to it	Dredging Renewable energy production (e.g. wind, wave, tidal)
D. **Tyldesley, A vision for marine spatial planning,** in: ECOS, 2006: pp. 33–39. Cited by 1/50 coded documents	A marine spatial planning system does not necessarily have to lead to a single system of planning, producing a single plan, or a single set og plans. IT could be established more as a discipline, or a process, that may result in several plans… Marine spatial planning should cover all forms of physical and spatial development, changes of use and all ongoing or proposed activities, seaward out to 200nm / the UK marine competency. It should operate at national and regional (sea-region) level.	-
D. **Peel,** M.G. **Lloyd, The social reconstruction of the marine environment: Towards marine spatial planning?**, Town Plan. Rev. 75 (2004) 359–378. doi:10.3828/tpr.75.3.6. Cited by 1/50 coded documents	Mirroring its terrestrial parent, marine spatial planning is advocated as a strategic, plan-led approach to help avoid or reduce conflict, to identify appropriate development and to enhance and protect important environmental assets from inappropriate development (DEFRA, 2002).	Fishing Eco-tourism Oil and gas extraction Aquaculture Marine Protected Areas
K. **McLeod,** H. **Leslie, Ecosystem-based Mangement for the Oceans**, Island Press, 2009. Cited by 1/50 coded documents	None available material.	-
T. **Blundell, Turning the Tide: Addressing the Impact of Fisheries on the Marine Environment,** R. Comm. Environ.	No explicit definition of MSP.	Fishing Aquaculture Conservation Dredging for sand and gravel Shipping

Pollution. Parlamient UK. (2004) 497. http://www.gov.scot/Publications/2006/06/05151958/0. Cited by 1/50 coded documents		Tourism Marine Protected Areas Conservation Hunting
B.S. **Halpern**, S. Walbridge, K.A. Selkoe, C. V. Kappel, F. Micheli, C. D'Agrosa, J.F. Bruno, K.S. Casey, C. Ebert, H.E. Fox, R. Fujita, D. Heinemann, H.S. Lenihan, E.M.P. Madin, M.T. Perry, E.R. Selig, M. Spalding, R. Steneck, R. Watson, **A global map of human impact on marine ecosystems,** Science. 319 (2008) 948–952. doi:10.1126/science.1149345. Cited by 1/50 coded documents	No explicit definition of MSP.	Fishing (Commercial and recreational) Coastal engineering Aquaculture Shipping
K. **McLeod**, J. Lubchenco, S. Palumbi, A.A. Rosenberg, **Scientific Consensus Statement on Marine Ecosystem-Based Management,** (2005) 1–21. doi:10.1080/13880290109353975. Cited by 1/50 coded documents	No explicit definition of MSP.	Habitat restoration Aquaculture Coastal development Fishing Military activities Shipping Conservation Marine Protected Areas
European Communities, EU Marine Strategy: The story behind the strategy., 2006. http://ec.europa.eu/environment/marine/pdf/eumarinestrategy_storybook.pdf. Cited by 1/50 coded documents	No explicit definition of MSP.	Fishing Oil and gas exploration Dredging and extraction of sand and gravel Shipping Tourism Conservation

F. **Douvere,** C. **Ehler, Introduction,** Mar. Policy. 32 (2008) 759–761. doi:10.1016/j.marpol.2008.03.019. Cited by 1/50 coded documents	No explicit definition of MSP.	Fisheries Tourism Marine protection
EC, Green Paper. Towards A Maritime Policy for the Union: A European vision for the oceans and seas, Communities. II (2006). Cited by 1/50 coded documents	No explicit definition of MSP.	Fishing Shipping Energy production
EC, Recommendation of the European Parliament and of the Council concerning the implementation of Integrated Coastal Zone Management in Europe (2002/413/EC), Off. J. Eur. Communities. L 148 (2002) 24–27. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:148:0024:0027:EN:PDF. Cited by 1/50 coded documents	No explicit definition of MSP.	Fishing Aquaculture Transport Energy Protection Cultural heritage Tourism and recreation Mining

Supplementary Material C. Results from the word count carried on the set of MSP definitions from the 30 defining documents (excluding the terms "marine", "spatial", and "planning").

Word	Count	**Word**	Count	**Word**	Count
uses	37	development	12	ecosystems	8
activities	31	ocean	12	services	8
process	29	conflicts	11	allocating	7
ecosystem	26	ecological	11	analyzing	7
based	22	future	11	coastal	7
human	22	area	10	decision	7
management	20	environment	10	plans	7
economic	19	usually	10	space	7
use	19	environmental	9	specific	7
areas	18	integrated	9	specified	7
objectives	17	reduce	9	activity	6
social	16	achieve	8	adaptive	6
plan	15	among	8		
comprehensive	14	current	8		

Supplementary Material D. Search words used to develop the word frequency analysis regarding human uses and activities included in MSP.

Human activities and uses included in MSP	Search words
Fishing (commercial and recreational)	Fisheries, fishing
Recreational activities (e.g. sailing, surfing and diving)	Recreation*
Environmental conservation/protection	conservation, protect*
Aquaculture	Aquaculture
Ports and harbours activities and developments	Port, ports, harbour, harbours
Renewable energy (e.g. wind farms)	Renewable energy, wind, wave, tidal
Shipping (cargo and transportation)	Ship*, cargo, transport*
Cultural conservation (e.g. heritage sites)	Heritage
Hunting	Hunting
Military activities	Military
Mineral resource extraction (e.g. oil, gas, sand and gravel)	Minerals, mineral, oil, gas, sand, gravel
Tourism	tourism

* Indicates that the word count is set to include stemmed words (e.g ship* = ship, shipping, ships etc.)

Supplementary Material E. Search words used to develop the analysis of how MSP can contribute to each of the UN SDG 14 targets.

SDG14 targets and indicators	Search words
14.1 By 2025, prevent and significantly reduce **marine pollution** of all kinds, … **14.1.1** Index of coastal eutrophication and floating plastic debris density	Pollution Litter Eutrophication
14.2 By 2020, sustainably manage and **protect marine and coastal ecosystems** … **14.2.1** Proportion of national exclusive economic zones managed using ecosystem-based approaches	Conservation Protect
14.3 Minimize and address the **impacts of ocean acidification**, … **14.3.1** Average marine acidity (pH) measured at agreed suite of representative sampling stations	Acidification Climate change
14.4 By 2020, effectively **regulate harvesting** and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices … **14.4.1** Proportion of fish stocks within biologically sustainable levels	Fish Illegal Unreported Unregulated
14.5 By 2020, **conserve at least 10 per cent** of coastal and marine areas … **14.5.1** Coverage of protected areas in relation to marine areas	MPA Protect Conservation
14.6 By 2020, **prohibit certain forms of fisheries subsidies** which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing … **14.6.1** Progress by countries in the degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing	Fish Subsidies
14.7 By 2030, **increase the economic benefits** to Small Island developing States and least developed countries from the sustainable use of marine resources … **14.7.1** Sustainable fisheries as a percentage of GDP in small island developing States, least developed countries and all countries	Fish Aquaculture Tourism Small island
14.A Increase **scientific knowledge**, develop research capacity and transfer marine technology … **14.a.1** Proportion of total research budget allocated to research in the field of marine technology	Technology Research Scientific

	BAT (Best available technology)
14.B Provide access for **small-scale artisanal fishers** to marine resources and markets **14.b.1** Progress by countries in the degree of application of a legal/regulatory/policy/institutional framework which recognizes and protects access rights for small-scale fisheries	Small-scale Artisanal Fish
14.C Enhance the conservation and sustainable use of oceans and their resources by implementing **international law** as reflected in UNCLOS … **14.c.1** Number of countries making progress in ratifying, accepting and implementing through legal, policy and institutional frameworks, ocean-related instruments that implement international law, as reflected in the United Nation Convention on the Law of the Sea, for the conservation and sustainable use of the oceans and their resources	UNCLOS Law

SUMMARY

This dissertation explores the practice of Marine Spatial Planning and its role in facilitating sustainability at sea. Five papers have been developed for this purpose. They contribute to the discussion of how Marine Spatial Planning is facilitating sustainability by exploring central elements of the EU Directive on Marine Spatial Planning as well as how ambiguous formulations in policies affect the practice and outcome. The concept of an 'ecosystem-based approach' is evaluated and best practices are compared. In relation to this, the assessment of collective pressure by Member States is evaluated and the concept of sustainability in relation to Marine Spatial Planning is explored and debated. Marine Spatial Planning is found to have a larger potential in facilitating sustainability, than what is currently perceived by established frameworks. Current practices in the EU vary greatly due to the ambiguous and open formulations of the Directive. While some practices take shape of an experimental implementation with successful and innovative outcomes, other practices neglects key elements such as the assessment of the collective pressure.

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